MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. XXXIII. *December* 13, 1872. NO. 2.

PROFESSOR CAYLEY, F.R.S., President, in the Chair.

J. A. Bennion, Esq., Pollard Street, Manchester,
Rev. J. G. S. Nichol, King James' Grammar School, Knaresborough,
E. Gay, Esq., Calcutta; and
W. Whitehouse, Esq., Roslin Hill House, Hampstead,
were balloted for and duly elected Fellows of the Society.

At the Meeting of November 8, the following gentlemen were balloted for and duly elected Associates of the Society:—
Dr. J. Janssen, Paris,
Prof. S. Newcomb, Washington,
Prof. H. A. Newton, Yale College, U.S.,
Prof. L. Respighi, Rome,
L. M. Rutherfurd, Esq., New York, U.S.,
Sig. G. V. Schiaparelli, Milan,
Prof. C. A. Young, Dartmouth College, U.S.,
Prof. Zöllner, Leipsig.

At this meeting, a resolution, proposed by the Rev. I. Vale Mummery and seconded by H. Perigal, Esq., was passed unanimously, expressing the deep regret with which the Meeting had heard of the death of Mrs. Mary Somerville (for many years one of the most distinguished Honorary Members of the Society), its admiration of her eminent talents and attainments, its sympathy with those whom she has left to mourn her loss, and its unfeigned respect for her honoured memory.

The Coloured Cluster about κ Crucis. By W. C. Russell, Esq.

The following Catalogue of Stars, and the map have been made for the purpose of ascertaining whether, as asserted, any remarkable change has taken place in the relative positions and colours of the stars since they were laid down by Sir J. Herschel at the Cape.

Of thirty-three stars, the differences in R.A. and Dec. were obtained with the position-micrometer, each difference in R.A. given in the notes is the mean of two observations, and in some cases the mean of several. The differences in declination are single measures.

The instrument used is a refractor, by Merz, $7\frac{1}{4}$-inches clear aperture, 10 feet 4 inches focus, with powers from 80 to 400. The colours were examined with a "Browning-With" reflector, of $8\frac{1}{2}$-inches, and found the same as given with the refractor.

Observations were begun on 25 March, 1872, but the majority of the measures (126 in R.A., and 63 in Dec.) were made on the night of 26th of March, which was a fine, clear night, with a black sky and the stars very steady; the stars (33) then measured were all that were visible of the cluster in full moonlight. From the positions thus determined the stars were laid down on a map of the same scale as the map herewith; as great change in No. 11 was indicated, 14 observations of R.A. were taken, giving a mean of $12^s{\cdot}3$, the extremes being $12^s{\cdot}0$ and $12^s{\cdot}6$.

On the 3rd of April, about 170 stars were entered on the map, by eye, assisted with the micrometer lines and the stars previously measured, the following night several additional stars were entered, and colour noted in Nos. 72, 78, and 80, all red, and 82 blue.

April 12, stars were clearly defined on a black sky and the whole cluster presented a beautiful appearance.

ζ was noted greenish white.

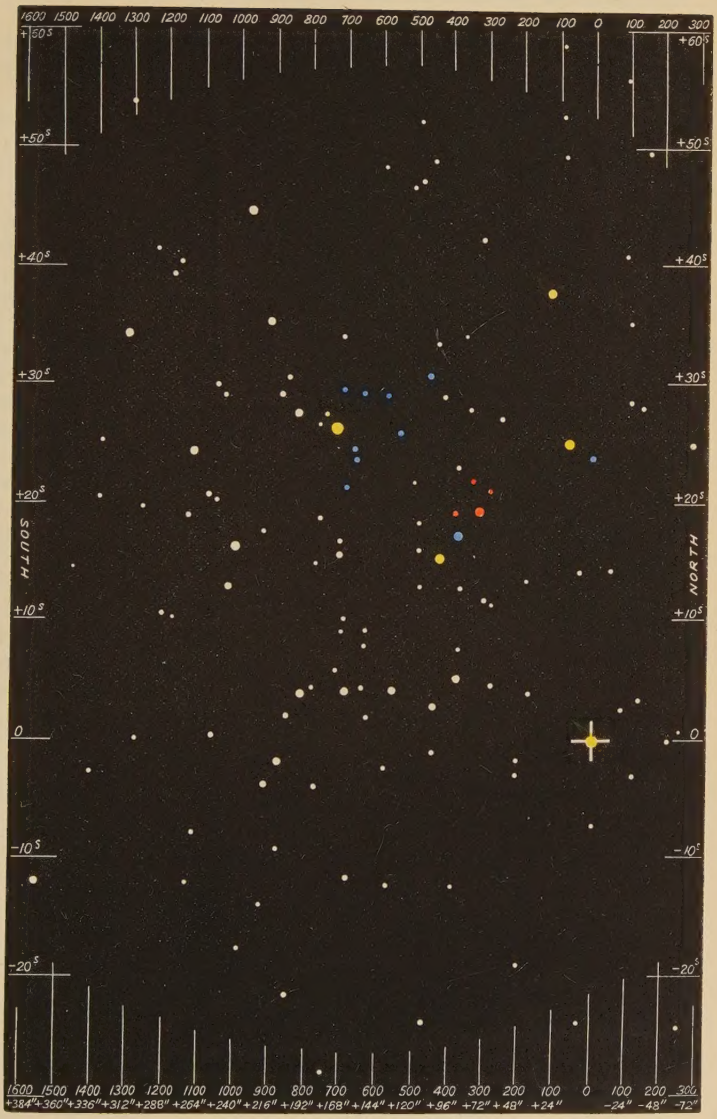
ε red.

ϕ blue.

α, β, γ, and δ yellow with tinge of green. These colours were verified on many occasions for all the stars except ζ, which is usually seen the same colour as α, β, γ, and δ.

δ, φ, and ε, are nearly in a straight line, when the micrometer line is made to bisect δ and ε; ϕ is on one side of it, and is not therefore more than its own diameter from the line joining δ and ε, and since the positions of these two stars are almost identical with H.'s, φ must have moved.

On the 12th, also, the positions of all the stars in the map were very carefully examined and corrected where necessary. Special care was bestowed on those that differ from H.'s map. [Several of the stars have evidently drifted. Notably three stars where lines $+ 50^s$ and $+ 120^s$ intersect (two small stars appear here which are not in H.'s map). Also Nos. 1, 5, 8, 9, 10, 11, 12, 14, 15, 21, 28, 57, 58, 94, 100, 107, and 109, with some others.



THE COLOURED CLUSTER ABOUT κ CRUCIS.

Five stars in H.'s list I could not see, of these 1 was 16th magnitude, 3 of the 15th, and 1 of the 13th, but I saw 25 which are not in his list, and which I think considering the difference in the instruments used, must have appeared since, especially Nos. 16, 19, 31, 69, 79, and 120, which are all in places which have evidently been examined by H.

May 13, estimated the magnitudes of all stars on the map and entered four new ones.

May 14, added nine stars to map, which now contained all the stars I have been able to see within the limits of the map.

As soon as the original map was thus completed, a catalogue of all the stars on it was made; by measuring the position of each with a scale made for the purpose, and substituting of course, in the case of the principal stars, the micrometer results. In this way the magnitudes of the stars are made easy of reference and the positions compared with those of H. determined in a similar way. The proofs of the map were pulled with the white lines extending across, and the positions of all the stars carefully compared with the original; as the white lines interfered with the beauty of the object they were all removed except such portions as remain to indicate their places, and if measures are required it is easy to continue the requisite lines with pencil and rule.

On comparing this with H.'s map it will be seen that the north and south points are reversed, an error having crept in H.'s map in this particular, probably the fault of the engraver, as both the objects on Plate I. of *Cape Observations* are affected by the same error, and H., at p. 15, says of Messier, 8, the first object, "Three pretty distinct streaks," "arched together at their *northern* extremities," these are south in the map, and, again, at p. 102, star A or No. 71, is said to be "*south* of the red star;" *i.e.*, No. 71 Σ, yet in the drawing it is to the north.

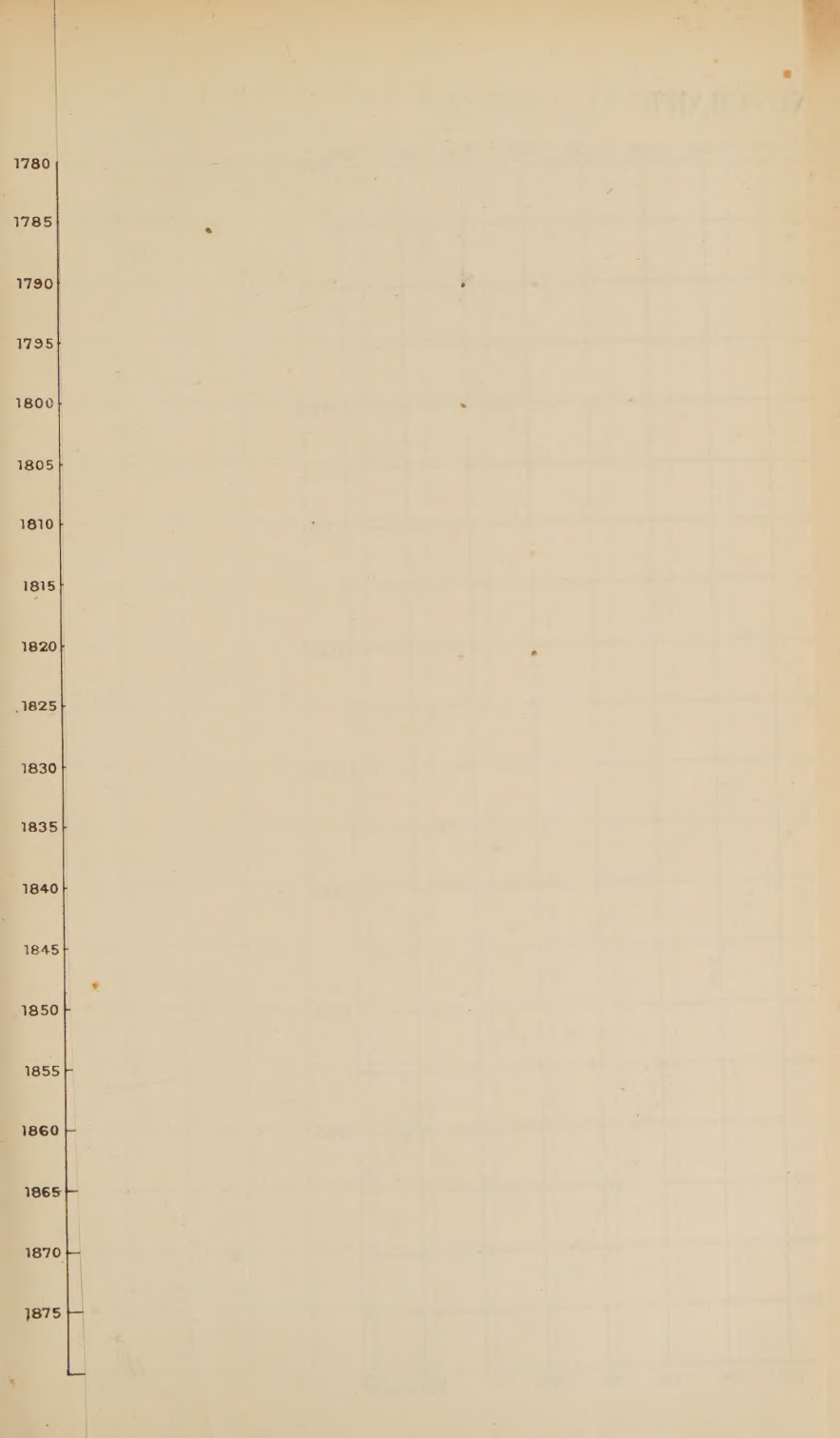
R.'s No.	H.'s No. and Letter.	Mag.	Secs. before α.	Secs. of Dec. + S. — N. of α.	Notes and Remarks.
			s	"	
1	1 π	10	27·8	+ 178·3	Mic. measures, 27ˢ·927ˢ·7 178″·1, 178″·5
2		12	24·8	— 60	Not in H.
3		11	24·5	+ 112	,, ,,
4		12	24·3	+ 10	,, ,,
5	2	11	21·3	+ 204·1	Mic. meas. 21ˢ·3 204″·1
6		11	19·0	+ 48	Not in H.
7		15	18·0	+ 240	,, ,,
8	6	15	14·5	+ 224	
9	4	12	12·8	+ 94	H. records a star No. 5 near this, which I did not see
10	3	13	12·2	+ 138	
11	11 χ	10½	12·3	+ 376	Mean of 14 measures in R.A. and 5 in Dec. showing since H. a change of 6ˢ·3 and 9″ in Dec. both increased
12	8	12	12·0	+ 272	

R.'s No.	H.'s No. and Letter.	Mag.	Secs. before α.	Secs. of Dec. + S. — N. of α.	Notes and Remarks.
			s	″	
13	7	10½	12·0	+ 163·1	Mic. meas. 12ˢ·0 163″·1
14	9	14	9·4	+ 214	
15	12	12	8·0	+ 270	
16		13	7·5	— 4	Not in H.
17	14	12	4·0	+ 224	
18	10	13	4·0	+ 184	
19		13	3·0	— 30	Not in H.
20	13	14	2·9	+ 52	
21	28	12	2·8	+ 340	
22	16	13	2·7	+ 142	
23	17 μ	10	1·7	+ 212·4	Mic. meas. 2ˢ·0, 1ˢ·4, 212″·4, 212″·3
24	15	14	2·0	+ 52	
25	18	13	1·0	+ 108	
26	21	12	0·3	+ 52	
27	20 α	6½			Yellow, with tinge of green
28	35	12	After α 0·1	+ 308	
29	19	11	0·2	+ 256	H. records two stars here, I could only see one
30	22	14	2·0	+ 206	
31		13	2·2	+ 152	Not in H.
32	24	12	2·3	— 22	
33	25	10½	2·8	+ 108·4	Mic. meas. 2ˢ·8, 106″·6, 110″·1
34	31	12	3·0	— 28	
35	27 ν	10½	3·5	+ 196·6	Mic. meas. 3ˢ·7, 3ˢ·3, 196″·8, 196″·4
36	32	10½	3·7	+ 136·3	,, ,, 3ˢ·9, 3ˢ·4, 135″·2, 137″·4
37	26	10	3·8	+ 164·7	,, ,, 3ˢ·8, 164″·7
38	29	13	4·1	+ 44	
39	30	12	4·3	+ 156	
40	34	13	4·3	+ 191	
41	33	11	4·8	+ 66·2	Mic. meas. 4ˢ·8, 66″·2
42	37	13	5·3	+ 90	
43	36	12	5·7	+ 176	
44	38	12	7·9	+ 90	
45	39	13	8·3	+ 153	
46	41	13	9·2	+ 168	
47	40	13	9·3	+ 155	
48	42	13	9·8	+ 172	
49	44	11	10·5	+ 282	
50	43	10	11·0	+ 291	
51	45	14	11·7	+ 70	
52	46 ω	11	12·1	+ 74·1	Mic. meas. 11ˢ·8, 12ˢ·3, 72″·1, 76″·1
53	47	12	12·4	+ 88	

R.'s No.	H.'s No. and Letter.	Mag.	Secs. before α.	Secs. of Dec. + S. — N. of α.	Notes and Remarks.
			s	"	
54	49	12	12·5	+ 114	H. records a star No. 50 near this, but I could not see it
55	48 ξ	9½	12·8	+ 243·5	Mic. meas. 13ˢ·0, 12ˢ·6, 244″·2, 242″·7
56	51	13	13·4	+ 44	
57	53	13	14·1	+ 10	
58	57	13	14·2	— 10	
59	54	11	14·8	+ 190	
60		11	14·8	+ 350	Not in H.
61	52 δ	7½	15·0	+ 103	Mic. meas. 15ˢ·1, 14ˢ·9, 103″·7, 102″·9, yellow, with tinge of green
62	55	12	15·3	+ 118	
63	58	10½	15·3	+ 176·6	Mic. meas. 15ˢ·3 15ˢ·3, 176″·2 177″·0
64	59 ο	9½	16·4	+ 241·0	,, ,, 16ˢ·3 16ˢ·4, 240″·5 241″·4
65	61	11	16·7	+ 174	
66	56 φ	8½	17·0	+ 90·2	Mic. meas. 17ˢ·0 16ˢ·9, 90″·1 90″·2, two observations make this star blue, one between blue and green
67	60	11	17·4	+ 224	
68	62	12	17·5	+ 120	
69		11	19·0	+ 274	Not in H.
70	65	11	19·0	+ 185	
71	63 ε	8	19·1	+ 75·8	Mic. meas. 19ˢ·0 19ˢ·2, 76″·2 75″·3, all observations make this star red
72	64 α	12	19·2	+ 92	Red
73		12	19·8	+ 304	Not in H.
74	67	13	20·3	+ 252	
75	68	13	20·5	+ 258	
76		12	20·5	+ 334	Not in H.
77	70	9½	21·2	+ 168·2	Mic. meas. 21ˢ·0 21ˢ·3, 168″·3 168″·0, blue
78	66	12	21·1	+ 70	Red
79		14	21·7	+ 121	Not in H.
80	69	12	21·7	+ 80	Red
81	71	13	22·7	+ 89	
82	74	11	23·8	+ 2	Blue
83	73 υ^1	9½	23·8	+ 156·9	Mic. meas. 23ˢ 9 23ˢ·6, 156″·6 157″·1, blue
84	72 η	8½	23·9	+ 270·8	,, ,, 24ˢ·2 23ˢ·5, 271″·0 270″·3
85	75 υ^2	9½	24·2	+ 158·0	,, ,, 24ˢ·5 23ˢ·9, 157″·5 153″·4, blue
86		12	24·7	+ 335	Not in H.
87	76 ι	9	24·7	— 68·2	Mic. meas. 25ˢ·0 24ˢ·4, 69″·0 67″·3
88	77 ζ	7½	24·9	+ 13·6	,, ,, 24ˢ·9 24ˢ·9, 14″·5 12″·6, green, with yellow tinge
89	78	9½	25·6	+ 132·7	Mic. meas. 25ˢ·3 25ˢ·8, 131″·4 134″·0, blue
90	80 β	7	26·3	+ 172·7	,, ,, 26ˢ·3 mean of 6 observations, 172″·7 mean of 3 observations, yellow tinge green
91	79	13	26·5	+ 183	
92	81	13	26·6	+ 62	

R.'s No.	H.'s No. and Letter.	Mag.	Secs. before α.	Secs. of Dec. + S. — N. of α.	Notes and Remarks.
93	85	13	27·4	+ ″83	
94	82 θ	8½	26·8	+ 201·3	Mic. meas. 26ˢ·7 26ˢ·9, 26ˢ·8 26ˢ·9, 201″·4 200″·5, 199″·8 199″·6
95	83	13	27·3	+ 182	
96	86	15	27·4	− 34	
97	88	15	28·0	− 26	
98	91	14	28·7	+ 101	H. records a star, No. 89, near this, which I did not see
99	84	13	28·7	+ 251	
100	90	9½	29·1	+ 215·7	Mic. meas. 29ˢ·3 28ˢ·9 29ˢ·2 28ˢ·8, 215″·1 215″·5 216″·2 215″·8
101	92	9½	29·7	+ 138·4	Mic. meas. 29ˢ·1 29ˢ·3, 138″·6 138″·1, blue
102	93	9½	29·2	+ 154·7	,, ,, 29ˢ·2 155″·5 154″·3, blue
103	95	9½	29·6	+ 167·5	,, ,, 29ˢ·4 29ˢ·7, 196″·3 166″·6, blue
104	87	13	29·8	+ 254	
105	94	9½	30·4	+ 110·1	Mic. meas. 30ˢ·5 30ˢ·3, 109″·5 110″·7, blue
106	96	13	30·6	+ 208	
107	97	12	33·1	+ 106	
108	99	14	33·7	+ 170	H. has another star near this, which I could not see
109	98	12	34·1	+ 89	
110		14	34·3	− 25	Not in H.
111	100 ρ	8½	34·6	+ 316·2	Mic. meas. 34ˢ·3 34ˢ·8, 316″·3 316″·1
112	101 χ	9½	35·6	+ 220·3	,, ,, 35ˢ·3 35ˢ·8, 219″·8 220″·9
113	102 γ	7	37·4	+ 26·1	,, ,, 37ˢ·2 37ˢ·5, 25″·6 26″·6 yellow tinge, green
114	104	14	38·5	+ 277	
115	105	14	40·5	+ 273	
116		14	40·7	− 22	Not in H.
117		14	41·6	+ 78	,, ,,
118	106	14	42·0	+ 296	
119	107 σ	9½	43·8	+ 233	Secs. after a rest on one obs. by mic.
120		15	46·4	+ 123	Not in H.
121	108	11	46·7	− 119	
122	109	12	48·0	+ 144	
123		14	49·0	+ 20	Not in H.
124		15	49·0	+ 108	,, ,,
125		14	49·3	− 34	,, ,,
126	110 τ	11	52·0	+ 118	
127		14	52·7	+ 22	Not in H.
128		12	53·4	+ 312	,, ,,
129		14	55·2	− 23	,, ,,
130		14	58·5	+ 22	,, ,,

The paper is accompanied by the following letter to the Secretary of the Royal Astronomical Society: —


1780
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I send herewith the result of some recent observations on the small coloured cluster about *κ Crucis*. Many of the stars have drifted considerably since the Cape drawing was made, and of the stars included in that drawing, there are five small ones that I could not see; but the most remarkable fact is, that using a $7\frac{1}{4}$ in. refractor I have detected twenty-five stars not recorded, and therefore, I think there can be no doubt, *not seen* by Sir John Herschel with his large reflector; and if in a small space like this twenty-five new stars may appear in so short a time, it is evident that more attention should be bestowed on clusters. The colours in this cluster are very beautiful, and fully justify Herschel's remark that it looks like a "superb piece of fancy jewellery."

I do not know whether the results sent are suitable for publication by the R. A. Society, but I have sent them for that purpose.

I also send my Annual Report for 1871.

The Observatory,
Sydney, New South Wales.

Note to accompany the Chart showing the relative position of the two stars in Castor. By J. M. Wilson, Esq.

The chart embraces a period of 160 years, from A.D. 1720 to A.D. 1880. The right hand curve has reference to the dates on the right side of the chart, and the left hand curve to the dates on the left of the chart. A change of angle is shown from 355° to 235°, the degrees marked at the top having reference to the upper or right-hand curve, and those at the bottom to the lower or left-hand curve. Part of the curve is repeated to show the continuity of curvature. The dots enclosed in small circles belong to the right-hand curve, the others to the left. Every observation made use of is included in the annexed list, which was furnished me by Mr. Gledhill, of Halifax.

Table I.

Date.	ϕ	Observer.	Date.	ϕ	Observer.
1719·84	355·88	B and P	1825·24	263·30	S
1759·80	323·78	B and M	1826·22	262·54	Σ
1779·85	302·78	H	1827·28	262·52	Σ
1783·64	293·05	..	1828·67	261·87	H
1791·15	292·95	..	1829·88	260·97	H
1792·16	297·27	..	1830·52	259·02	H
1795·95	283·88	..	1830·95	258·80	Sm
1800·27	284·32	..	1831·22	258·32	Da
1802·08	282·77	..	1832·12	258·42	Da
1803·19	280·55	..	1833·15	258·10	Da
1814·83	272·87	Σ	1834·08	257·23	Da
1816·97	270·00	H	1835·33	255·48	Σ
1820·34	268·99	Σ	1836·31	255·20	Sm
1821·21	267·12	H and S	1838·21	254·90	Da
1822·01	266·81	Σ	1840·20	254·13	Da
1823·11	264·98	H and S	1841·11	252·82	M

Date.	θ	Observer.	Date.	θ	Observer.
1842·08	253·38	Da	1859·98	243·6	Mo
1843·13	252·30	Sm	1860·22	242·7	Da
1845·95	249·80	H	1863·00	243·0	R
1846·73	249·46	H	1863·02	242·7	R
1847·25	249·85	Da	1863·03	241·6	De
1848·28	249·54	W C B	1863·12	242·3	R
1849·32	248·97	Da	1863·51	242·	Da
1851·04	248·67	F	1864·30	242·1	Da
1852·66	246·39	M	1865·04	239·71	K
1853·34	246·26	M	1865·30	241·4	Da
1854·38	244·72	M	1865·31	241·4	Da
1855·31	243·60	M	1866·09	243·2	T
1855·82	245·1	Se	1866·13	237·36	T
1856·20	245·4	De	1866·17	240·6	T
1856·35	243·7	M	1867·09	242·9	T
1856·73	245·5	J	1867·27	242·9	T
1857·34	244·2	De	1871·99	237·06	K
1857·36	242·9	M	1870·02	236·58	K
1857·77	245·1	J	1872·20	237·2	S and W
1858·26	244·4	Mo	1872·26	238·26	S
1858·37	244·1	M	1872·27	238·9	S
1859·26	243·8	Mo	1872·28	237·7	W
1859·36	242·7	M			

The interpolating curve gives a series of readings of dates corresponding to every 5°. These are corrected, to eliminate errors of drawing and of measurement, by taking differences as far as the third order (what Herschel calls "smoothing" the curve), with the following results, taken at intervals of 10°.

Table II.

θ	t	θ	t
340	1740·46	280	1804·89
330	1752·44	270	1811·89
320	1763·14	260	1819·39
310	1773·34	250	1826·45
300	1783·49	240	1836·49
290	1793·89		

From these $\frac{dt}{d\theta}$ is computed at each epoch, and thence r, since $r^2 \propto \frac{dt}{d\theta}$ and then r and θ converted into rectangular co-ordinates. The equation

$$0 = 1 + \alpha x + \beta y + \gamma x^2 + \delta xy + \varepsilon y^2$$

is assumed, and the co-efficients, α, β, γ, δ, ε, determined by the method of least squares. This solution of the equations, which is very laborious, has been again repeated by Mr. Henry Stevenson,

of Bedford, to a higher degree of accuracy than previously, and the co-efficients obtained differ slightly, and in two instances, rather seriously, from those given in the Supplementary Number of the *Monthly Notices* for 1872. His latest result is

$$\begin{aligned} \alpha &= \cdot 0088906 \\ \beta &\quad \cdot 0050951 \\ \gamma &\quad \cdot 0000054 \\ \delta &\quad \cdot 000032 \\ \varepsilon &= - \cdot 0000331 \end{aligned}$$

The results of substituting these values in the ten equations derived from Table II. are, according to Mr. Stevenson,

In	(1)	$= -\cdot 2120478$	In	(6)	$= \cdot 0762893$
	(2)	$-\cdot 0412761$		(7)	$\cdot 0617704$
	(3)	$\cdot 0334101$		(8)	$\cdot 0381189$
	(4)	$\cdot 0676907$		(9)	$\cdot 0053100$
	(5)	$= \cdot 0799079$		(10)	$= -\cdot 0423452$

This shows that the early observations are incompatible with the rest, as the result of substitution is so large ; and they have, therefore, prejudicially affected the conclusion to some extent. The orbit so determined has an eccentricity

$$e = 1\cdot 339863.$$

As the interest in *Castor's* orbit lies principally in the fact of its being or not being hyperbolic, we have not attempted to work it out beyond this point. I have furnished the elements given above as they may, perhaps, assist some one in repeating the calculation, and, at any rate, show exactly on what data the conclusion rests.

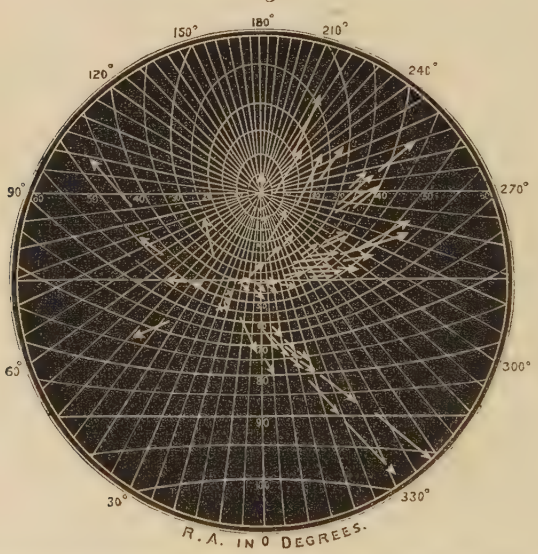
Temple Observatory,
Rugby, Nov. 1872.

Meteor Shower of November 27th, 1872, observed at Newcastle-upon-Tyne. By Prof. A. S. Herschel, F.R.A.S.

The meteors were first noticed a few minutes before six o'clock, and I commenced recording their apparent paths, with a perfectly clear sky at six o'clock. Two students of the Physical Science College, Mr. E. Haigh and Mr. F. Hurman, began to count their numbers at $6^h\ 10^m$, their backs being against a high wall facing nearly due west, and about four-fifths of the western sky being well within their view. They counted aloud to prevent reduplication, and at $6^h\ 45^m$, when clouds drawing over from the north-east began to encroach upon the western half of the sky they had reckoned 453 meteors in thirty-five minutes. The shower occurring unexpectedly our party was found to be without a watch, but the time was occasionally given by bystanders and being rectified at each quarter of an hour by the neighbouring

town clock, which is kept in excellent agreement with the daily time-gun fired from Edinburgh, the times recorded during the observations are probably correct to within a minute or two from the Greenwich mean time. The meteors came in bursts, with occasional short lulls between them; such outbursts were noticed at $6^h\ 9^m$, $6^h\ 29^m$, and $6^h\ 35^m$, when seven or eight meteors of 1st and 2nd magnitudes in less than a minute passed undescribed, while the apparent path of one meteor was being recorded. Among those whose paths were mapped, one meteor was somewhat brighter, and four meteors as bright as *Sirius*; nine were as bright as 1st; twenty-seven as bright as 2nd; and fourteen not brighter than 3rd magnitude stars. The total number of fifty-five meteors was distributed in brightness in the following proportions, of meteors

Fig. 1.



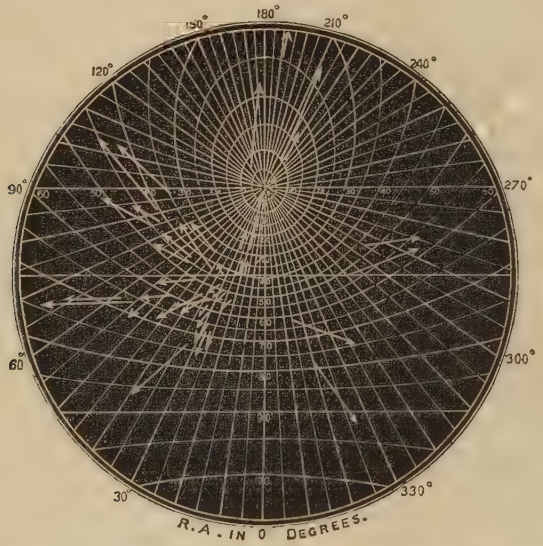
Meteor-tracks observed at Newcastle-upon-Tyne. 1872, Nov. 27th, 6^h-7^h G.M.T.; in R.A. and N. Decl.

somewhat brighter than or as bright as *Sirius*, 1st, 2nd, 3rd, or less than 3rd magnitude stars. Meteors mapped 9, 17, 49, 25 per cent; total 100.

The most frequent brightness was that of second magnitude stars. Of such meteors groups often appeared together, with short courses near the radiant point, or with longer, slightly diverging courses at some distance from it. A few such meteors were also observed nearly or quite stationary among the fixed stars, appearing and disappearing with little or no variation of their apparent place during the short period of their visibility. The courses of such meteors showed the existence of a considerable diversity of radiant points occupying a region extending, apparently from near the star β *Trianguli* to near θ *Cassiopeiæ*, or to between

ξ *Cassiopeiæ* and the stars 51, 54 *Andromedæ*, several degrees in breadth. For the purpose of determining as exactly as possible the average centre of divergence of the meteors in this region, the apparent paths of the above-described fifty-five shooting stars seen between 6^h and 7^h were recorded by the stars; and the recorded paths were afterwards drawn upon a plane perspective chart having the constellation *Andromeda* near the centre of the map. The backward prolongations of 60 per cent of the meteor-paths thus drawn pass through a small circular area about 5° in diameter, having its centre at a point in R.A. 20°, N. Decl. 40° upon the map, whose epoch is 1860. In the accompanying planisphere (fig. 1) the apparent paths are represented in R.A. and declination, as they were recorded upon the plane-perspective

Fig. 2.



Meteor-tracks observed at York and Birmingham, 1872, Nov. 27th, 6^h to 10^h 15^m P.M.; in R.A. and N. Decl.

map. Figure 2 represents a similar projection of twenty-three meteor-tracks recorded by Messrs. T. H. Waller, E. Grubb, and S. P. Thomson at York; and of seventeen meteors mapped by Mr. W. H. Wood at Birmingham between 5^h 50^m and 10^h 15^m G.M.T. on the 27th. The times of observations of the latter meteors were nearly equally distributed during the period of the watch; and at each station a small circular area, 6° or 8° in diameter, with its centre at R.A. 20°, N. Decl. 45°, includes the backward prolongations of between 60 and 70 per cent of all the meteor-tracks which were recorded. The position of the former centre of divergence is near the small star *v*, and that of the latter near the small star *ω Andromedæ*. A list of the apparent aths, and times of appearance of the shooting-stars observed at

Newcastle-on-Tyne, will be communicated to the Society at its next Meeting.

Among the best ascertained positions of the radiant point, some which were published in the daily and weekly journals soon after the appearance of the shower, and others which, where not otherwise stated, were communicated to me by the observers, including all the carefully described centres of divergence of the shower, that have reached me, are contained in the following list. They are arranged in their order of R.A.; and on the accompanying map of the chief stars in *Perseus*, *Cassiopeia*, and *Andromeda*, among which they are placed, the numbers of the radiant points refer to the successive numbers of their arrangement in the list.

Chart of the Radiant Points contained in the present list.

It will be seen from the number of the positions in this list (Nos. 6–11, as well as Nos. 5, 12, 13, 14, 18, 19, 20, 21), close to γ and χ *Andromedæ*, that the average radiant point of the shower was certainly not far distant from a point nearly between those stars. Omitting only the outlying radiant points Nos. 1, 2, 16, 17, and 22, near ξ *Cassiopeiæ*, χ *Persei*, and *Caput Medusæ*, as belonging to possible branches of the meteor stream of which the radiants 3, 4, 15, may themselves be intermediate links, the average of all but those five radiant positions is in about R.A. 24°·5, N. Decl. 44°·6. If the three somewhat widely placed radiant points Nos. 3, 4, 15, are also omitted for a nearer approximation, the right ascension is somewhat increased, while the

Ref. No.	Observer.	Place of Observation.	Period of Observations 1872, Nov. 27. From	To	Position of Radiant Point. R.A.	N. Decl.	By Neighbouring Fixed Star.	Reference.
			h m	h m	°	°		
1	W. H. Wood	Birmingham	6 0	10 15	5	+50	ξ Cassiopeiæ	Com. by Mr. Wood
2	E. V. Piggott	Malpas	about	7 0	9	+50	ξ Cassiopeiæ	"Nature," Dec. 5
3	J. J. Plummer	Durham	about	7 0	15	46·5	φ Andromedæ	Com. by Mr. Plummer
4	H. Weightman	Oundle	5 30	8 15	18	51	½ (ℓ Cassiopeiæ, υ Persei)	The "Times," Nov. 29
5	A. S. Herschel	Newcastle-on Tyne	6 0	6 45	20	40	υ Andromedæ	Com. by Prof. Herschel
6	J. G. Galle	Breslau (Germany)	6 20	7 50	22	42	Ditto	Breslau Journal, from Dr. Galle
7	Mr. Kuobel	Burton-on-Trent	5 35	7 50	22·5	44	χ Andromedæ	The "Times," Nov. 29
8	Dr. Marth	Gateshead	about	6 30	24·5	43	χ Andromedæ	Com. by Dr. Marth
9	T. P. Barkas	Newcastle-on-Tyne	about	6 30	26·5	43	χ Andromedæ	Com. by Mr. Barkas
10	T. W. Backhouse	Sunderland	5 30	11 5	25	44	χ Andromedæ	Com. by Mr. Backhouse
10 bis	T. H. Waller & S. P. Thomson	York	6 0	10 15	25	45	χ Andromedæ	Com. by Mr. Waller
11	R. Grant & G. Forbes	Glasgow	5 30	10 30	25	45	χ Andromedæ	Com. by Prof. Grant
12	W. Swan	St. Andrews	8 20	..	25	48	φ Andromedæ	"Nature," Dec 5
13	E. J. Lowe	Beeston	5 50	10 30	26·2	46·2	γ Andromedæ	The "Times," Nov. 29*
14	S. J. Perry	Stonyhurst	9 20	9 40	26·6	43·8	γ Andromedæ	"Nature," Dec 5
15	E. Heis	Munster (Germany)	8 0	9 0	27	50	φ Persei	Münster and Cologne Journals, from Dr. Heis
16	J. J. Plummer	Durham	at	9 45	27	56	½ (χ Persei, δ Cassiopeiæ)	Com. by Mr. Plummer
17	J. B. Smith	Chesterfield	at	7 0	29	59	½ (χ Persei, ε Cassiopeiæ)	Com. by Rev. S. J. Perry
18	W. F. Denning	Bristol	6 0	6 30	29	46	γ Andromedæ	The "Times," Nov. 29
19	G. Lespiault	Bordeaux (France)	5 30	10 0	28	42	γ Andromedæ	Nov. 29, Bordeaux, "La Gironde," Journal
20	H. van de Stadt	Arnhem (Holland)			28	42	γ Andromedæ	Arnhem Journal from H. van de Stadt
21	F. Denza	Moncalieri, Turin (Italy)			28	+42	γ Andromedæ	Com. by F. Denza
22	W. Garnet	Clitheroe	7 50	8 35	40	+35	r Caput Medusæ	Manchester "Examiner and Times."

* It appears to be by a misprint in the "Times" of this date, that the place of the radiant point determined by Mr. Lowe, here taken at R.A. $1^h\,45^m$, is there given as $2^h\,45^m$.

north declination is diminished, so that the average position of the fifteen remaining places (Nos. 5-14, and 18-21) is found to be at about R.A. 25°·4, N. Decl. 43°·7, extremely near to the place of the cometary radiant point as computed for the Comet of Biela at its last return in 1852, in R.A. 23°·4, N. Decl. 43°·0. A tendency to elongation of the radiant region from this point towards *Cassiopeia* and *Perseus*, appears to deserve attention from the numerous outlying positions of radiant points which appear, especially towards a late period of the shower, to have been distinctly indicated in that direction. Neither the diurnal motion of the heavens while the radiant remained, throughout the observations, within 20° or 30° from the zenith, nor the various velocities of the meteors, all moving in originally parallel streams (and thence departing from apparent parallelism by the effect of their relative motions with respect to the Earth), can explain the extension of the radiant area in this direction; because, in the latter case the elongation would be nearly in the direction of the stars β and γ *Andromedæ*, these stars pointing nearly towards the anti-apex of the Earth's way, which at the time of the Earth's transit through the meteor stream was situated nearly in R.A. 336°, S. Decl. 11°; and the observed elongation, if it should not arise from accidental errors, or from insufficient numbers of the observations, is in general nearly transverse to this direction, or nearly in that of the Sun's position at the time of the observations. A general diffuseness of the radiant region towards the direction of *Cassiopeia*, appears to be pretty certainly indicated by the results carefully obtained by some observers. The positions given by the first four named in the present list, together with those of the Rev. J. B. Smith at Chesterfield, and Dr. Heis at Munster, may be cited as affording positive evidence that, perhaps at a somewhat late period of the shower an unmistakable tendency of the meteors to diverge from a radiant point in higher north declination than on its first appearance was clearly recognised. During the early hour (between 6^h and 7^h P.M.) of the observations at Newcastle-upon Tyne, several meteor tracks from an extremely northern branch of the radiant space were recorded both in distant flights, and in occasional bursts of foreshortened tracks diverging together from points near ϕ *Persei* and ξ *Cassiopeiæ*, which appeared to indicate an activity of these remote radiant centres even during the early period of the gradually increasing intensity of the shower.

Observations of the Meteoric Shower of November 27, 1872, *made at Glasgow Observatory.* By Prof. Grant.

The meteoric shower to which public attention was drawn by Prof. Herschel in a recent impression of the *Monthly Notices*, was seen here on the evening of the 27th of November under

most favourable circumstances. The phenomenon was first perceived at $5^h\ 15^m$, and it continued to be observed until $11^h\ 50^m$ without the slightest interruption from clouds. A very few minutes of observation sufficed to convince me that the meteors were increasing in number, and that consequently the time of the maximum of the shower had not yet arrived. It was not long before it became evident that the position in the heavens from which the meteors appeared to diverge was situation a little below the constellation of *Cassiopeia*, and that it could not be far removed from *γ Andromedæ*.

In their general features the meteors did not differ from those of the great display of November 13–14, 1866. They were, however, obviously less brilliant. Their normal colour was white, with a pale train tinged now and then with a very faint greenish hue. The head seldom equalled in brightness a star of the first magnitude. From time to time, however, a meteor of unusual splendour would appear, nearly rivalling *Jupiter* in brightness. In such cases the train, especially when breaking up, exhibited a reddish tinge. In two instances of large meteors (those of $8^h\ 13^m$ and $9^h\ 33^m$) the colour of the train was conspicuously green. In general, however, there was an absence of the brilliant emerald hue which formed so conspicuous a feature of many of the larger meteors of November 1866. The time of visibility of a meteor did not exceed two or three seconds. In two or three instances of bright meteors, however, the *débris* of the train continued visible for about thirty seconds. The arc described varied as usual from zero to forty or fifty degrees. I was unable to detect any pronounced difference in the angular velocity of the meteors as compared with the meteors of November 1866. During the whole time of the occurrence of the shower I directed especial attention to the region of the heavens from which the meteors were issuing with the view of detecting stationary or nearly stationary meteors, having been convinced from my experience of the meteoric shower of November 1866, of the facility with which such meteors indicate the position of the radiant point. Several meteors of this class were seen during the progress of the shower. At $8^h\ 43^m$, at $9^h\ 23^m$, and at $9^h\ 35^m$, absolutely stationary meteors were perceived. They rapidly swelled out without any vestige of a train, and then suddenly collapsed. They all concurred in placing the radiant point in a position midway between *γ Andromedæ* and 51 *Andromedæ*, perhaps a little nearer to the former star than to the latter. Assuming the position of the radiant point to be midway between the two stars just mentioned, it would thus be situated in R.A. 26°, Decl. N. 44°. This conclusion was supported by the observations of nearly stationary meteors in the vicinity of the radiant point. On the other hand, the courses of the more distant meteors when traced back, although in general assigning the same position to the radiant, appeared in many instances to come from a higher region situated in *Cassiopiea*. Of this fact (which is otherwise indicated

by the projection of the observations*) I do not entertain the slightest doubt, my attention having been directed to it early in the evening.

In order to ascertain the time of occurrence of the maximum of the shower it was necessary to count the number of meteors visible. At first it occurred to me to place two observers, one looking towards the region of the radiant point, and the other towards the opposite region, but I found that the attempt to carry into effect this arrangement introduced confusion. I therefore directed the observer always to keep the star γ *Andromedæ* as the centre of vision, and to continue counting as many meteors as he could without turning round. The counting of the meteors commenced at $5^h\ 30^m$, and was prosecuted without intermission until $11^h\ 50^m$; it consequently embraced an interval of $6^h\ 20^m$. The operation was effected by counting the number of meteors visible in each successive interval of five minutes. The meteors counted were thus parcelled out into seventy-six groups, each group extending over five minutes. The number of meteors counted in the first group ($5^h\ 30^m$ to $5^h\ 35^m$) amounted to 40. The number of meteors in the maximum group ($8^h\ 10^m$ to $8^h\ 15^m$) was 367. The number of meteors in the last group ($11^h\ 45^m$ to $11^h\ 50^m$) fell to 6. Taking the first seventy-two groups and forming them into twenty-four groups of fifteen minutes each, we have the following results,—

Quarter of Hour ending h m	No. of Meteors Counted.	Quarter of Hour ending h m	No. of Meteors Counted.	Quarter of Hour ending h m	No. Meteors Counted.
5 45	150	7 45	881	9 45	233
6 0	174	8 0	930	10 0	246
6 15	292	8 15	1070	10 15	190
6 30	507	8 30	777	10 30	116
6 45	643	8 45	599	10 45	111
7 0	840	9 0	413	11 0	74
7 15	721	9 15	418	11 15	48
7 30	890	9 30	213	11 30	22

It is clear that the maximum of the shower occurred about $8^h\ 10^m$. The aggregate number of meteors counted from $5^h\ 30^m$ to $11^h\ 50^m$ (by one observer) amounted to 10,579.

The times above given are in Greenwich mean time. The chronometer with which the meteors were counted was 30^s slow. The results are uncorrected for this error. The meteors were counted by Mr. William Scouller and Mr. James Gray. The foregoing numbers are the results obtained by *one* observer, looking always towards the region of the heavens in which the radiant point was situated.

Early in the evening I had the pleasure of being joined at the Observatory by Prof. George Forbes, who will doubtless communicate to the Society an account of his observations.

* These observations, including other details of the phenomenon, have been communicated to Prof. Herschel with the view of being incorporated in the Annual Report of the British Association Committee on Luminous Meteors.

Great Shower of Meteors seen on the 27th of November, 1872, at the Highfield House Observatory, near Nottingham. By E. J. Lowe, Esq.

The following uninterrupted observations on this great meteor-shower, extending over five hours, may perhaps be of some value for comparison with those recorded in other places.

The meteors were first seen by my farm-man at $5^h\ 5^m$, and by my assistant at $5^h\ 10^m$. Unfortunately having been detained later than usual at our County Hall, it was $5^h\ 20^m$ before I saw the meteors; from this time, however, I watched them until reaching the observatory at $5^h\ 50^m$, when more careful observations were commenced. The sky was cloudless (with a white fog in the valley) until near $10^h\ 30^m$, so that the shower was seen under very favourable circumstances.

The radiant point was more carefully watched than any other portion of the phenomenon, and was considered to be an area of about 1° in diameter (or rather an oval area), as the bulk of the meteors occupied a perpendicular line across this area. With very few exceptions, the meteors could be traced to this radiant, and no less than twenty were detected *motionless* within the area.

The striking feature (more especially in the earlier portion of the display) was the extreme smallness of the great portion of meteors, not one in ten being equal to a star of the third magnitude, and many were as minute as the smallest visible stars and might aptly be called *meteor dust.* As the period advanced there was a marked though gradual increase in the size and brightness, especially after 7 P.M. and before 9 P.M., more especially in those meteors considerably removed from the radiant.

Near the radiant the meteors were the smallest, increasing in size, brightness, and length of path amongst the stars, as their distance from this point increased, but in no instance did I see a meteor as large as *Venus* when at her brightest.

There was a marked similarity between the meteors. All had tails, and indeed, with the exception of the larger ones, nothing beyond the tail or spark-like character could be seen. None of the smaller meteors were observed to vary in colour from that of the ordinary colour of the fixed stars, and a large proportion assumed the appearance presented by a descending rocket-stick.

The meteors differed considerably as regards apparent speed from those of the ordinary November epoch, being not nearly so rigid nor as a rule did they leave so continuous a streak in the sky, in fact but few exhibited continuous streaks, and these were all red in colour. Then, again, in the ordinary November shower there were many more large meteors.

From the difficulty in detecting all the very small meteors, I am inclined to place the figures given below as the actual amount.

Between 5.10 P.M. and 5.50 P.M. my assistant counted an average of eighty-three per minute on a quarter of the sky, and this would give 13,280 additional meteors not included in the enclosed estimate.

Twenty meteors were seen at the radiant which did not move amongst the stars.

Of these the one seen at $7^h\ 8^m\ 15^s$ was equal to a first magnitude star, those at $6^h\ 3^m$, $6^h\ 41^m$, $7^h\ 7^m\ 10^s$, $7^h\ 22^m$, $7^h\ 36^m\ 5^s$, $8^h\ 7^m$, $8^h\ 41^m\ 30^s$, $8^h\ 50^m$, and $9^h\ 6^m$, were all equal to 2nd magnitude stars, whilst the remainder seen at $6^h\ 11^m\ 10^s$, $6^h\ 44^m$, $7^h\ 4^m$, $7^h\ 12^m\ 20^s$, $7^h\ 59^m$, $8^h\ 4^m$, $8^h\ 5^m$, $8^h\ 10^m$, $9^h\ 16^m\ 12^s$, and $9^h\ 37^m$, were only equal to 3rd or 4th magnitude stars. The larger ones were orange red, and all disappeared suddenly on attaining their maximum brightness.

Only one meteor was seen to move across this radiant, though several crossed the second radiant, and most of the meteors with *smallest paths* started a little *without* this space, and none of these were as brilliant as nine of the largest *stationary* meteors.

There can be no doubt that a small proportion of meteors came from a second radiant, and this was further confirmed by a motionless meteor on this second radiant point. (Could these two points be referred to the two nuclei of Biela's Comet?)

		h m		′ °
First radiant	R.A.	1 45	Decl. N.	46 15
Second radiant	R.A.	1 55	Decl. N.	41 30
Difference		0 10		4 45

Number of meteors registered in a fourth part of the sky,—

Time. h m	Meteors per Minute.	Time. h m	Meteors per Minute.
5 50 P.M.	83	8 4	71
6 1	61	8 20	59
6 11	62	8 35	39
6 15	91	8 50	20
6 20	104	9 5	18
6 30	111	9 15	31
6 50	101	9 39	20
7 10	61	9 50	16
7 29	84	10 10	12
7 45	68	10 30	6
7 55	120		

Number of meteors registered in a fourth part of the sky from extra half-minute observations,—

h m	h m		
6 16 and	6 20	average per minute	= 97
6 50 and	7 10	„ „	= 81
7 55 and	8 4	„ „	= 95
8 20 and	8 35	„ „	= 49
9 15 and	9 30	„ „	= 25
9 50 and	10 10	„ „	= 14

Number of meteors registered in a fourth part of the sky from single minute observations,—

h m	h m		
5 50 and	6 15	average per minute	= 74
6 20 and	6 50	„ „	= 105
7 10 and	7 30	„ „	= 72
7 30 and	7 45	„ „	= 76
7 45 and	7 55	„ „	= 94
7 55 and	8 4	„ „	= 95
8 4 and	8 20	„ „	= 65
8 20 and	8 35	„ „	= 49
8 35 and	8 50	„ „	= 29
8 50 and	9 15	„ „	= 23
9 30 and	9 50	„ „	= 18
9 50 and	10 10	„ „	= 14
10 10 and	10 30	„ „	= 9

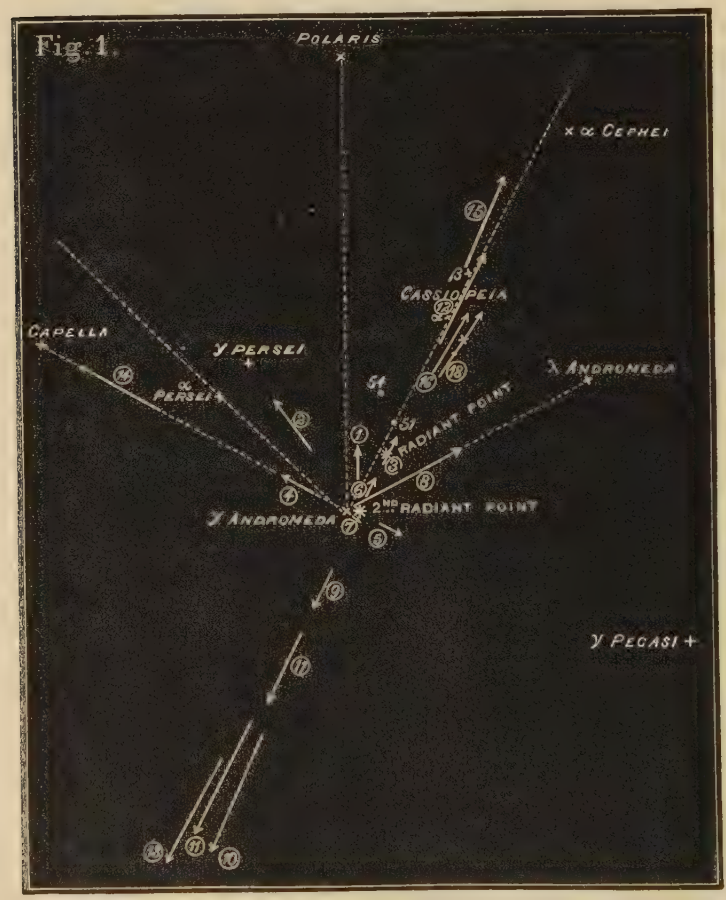
Estimated number of meteors that fell during the annexed period,—

h m	h m		
5 50 to	6 15	number of meteors	1850
6 15 to	6 20	„ „	480
6 20 to	6 50	„ „	3150
6 50 to	7 10	„ „	810
7 10 to	7 55	„ „	3645
7 55 to	8 4	„ „	950
8 4 to	8 20	„ „	1040
8 20 to	8 35	„ „	735
8 35 to	9 15	„ „	810
9 15 to	9 30	„ „	375
9 30 to	9 50	„ „	360
9 50 to	10 10	„ „	280
10 10 to	10 30	„ „	180
		Total	14,665

The above amount multiplied by four gives the immense

number of 58,660 meteors as actually falling between 5.50 and 10.30 P.M.

The method adopted in counting the numbers per minute *in the dark*, is the same that I have been in the habit of using



Showing a Second Radiant near *γ Andromedæ*.

in counting lightning-flashes, standing where I can hear the tick of a clock, a stroke is made on a slate every half minute.

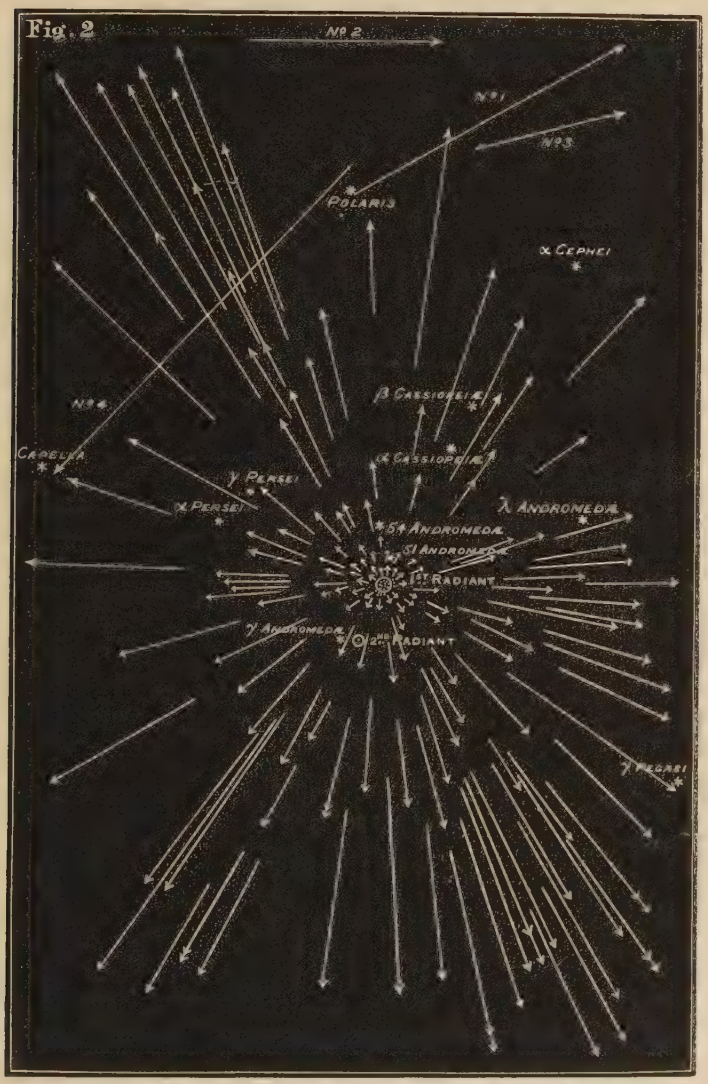
For example,—

0 0 1 1 1 2 1 2 0 0 0 2 3 4 2 1 0 0 1 1 2 4 4 4 3 2 1 2 2 4 = 50 in 30″

being the first half minute counted at $6^h\ 50^m$.

o o o o 1 o o o o 1 1 o o o o o o o o o o 1 o 1 o o o 1 o o = 6 in 30″

being the first half minute counted at 10^{h} 10^{m}.



Showing the Radiant, also four discordant Meteors.

The above method has been found so simple that I recommend its adoption by other observers.

If we examine the example as recorded at 6^{h} 50^{m} we shall find that whilst in the first 5″ the meteors were falling at the rate of 96 per minute, in the last five seconds the rate was 336

per minute. This method of recording therefore not only gives the number per minute, but also the greater or less frequency in different parts of a minute.

Fig. 2 is a chart of 154 meteors seen during the evening, four of which are discordant. Sixteen of these were observed between 5^h and 6^h P.M.; 34 between 6^h and 7^h; 35 between 7^h and 8^h; 31 between 8^h and 9^h; 27 between 9^h and 10^h; and 11 between 10^h and $10^h\ 30^m$ P.M.

There were but few meteors between north and east, and in west except near the radiant point. In both portions of the sky, however, trees somewhat interfered with the view, and it is well to add that the horizon-all round is hid by trees.

At $8^h\ 52^m$ a meteor of a *red* colour was noticed close to *γ Andromedæ*, which was at first very small, but rapidly increased in size and brightness, until at its maximum it was fully equal to the brilliancy of that star. This meteor never moved in the slightest degree amongst the stars, and it was the only motionless meteor that was observed excepting those seen at the No. 1 radiant point. This meteor suddenly disappeared at its maximum brilliancy, after lasting almost 4 sec.

Although no other motionless meteors were seen at *γ Andromedæ*, yet on examining the records made, no less than eight others were found to have moved from this second radiant point, and these are marked Nos. 1, 2, 3, 4, 5, 6, 8, and 14, whilst nine others might be referred to either radiant, and these are marked 9, 10, 11, 12, 13, 15, 16, 17, and 18 (see fig. 1).

The following are the records of these meteors,—

No. 1. Seen at $6^h\ 21^m\ 10^s$, equal to 3rd magnitude star, started from a point 1° north of *γ Andromedæ* and moved 5° in the direction of *Polaris*, duration 1 sec., ill-defined, colourless.

No. 2. Seen at $6^h\ 26^m$, equal to 2nd magnitude star, moved from the direction of *γ Andromedæ* towards *γ Persei*, starting at a point about 6° from the former star, and moving 10 degrees amongst the stars. Colour orange; duration 1·2 sec.; separate stars in its track that disappeared instantly. This vanished at its maximum brightness.

No. 3. Seen at $7^h\ 4^m\ 5^s$, equal to third magnitude star, moved from the direction of *γ Andromedæ* towards *α Cephei*, starting at a point between the two radiants, about 1° 30′ from the first radiant, path 3°. Colourless; duration 0·8 sec.

No. 4. Seen at $7^h\ 12^m$, equal to 2nd magnitude star, moved from the direction of *γ Andromedæ* towards *Capella*, path about 3°, starting about 5° from *γ Andromedæ*. Colour somewhat red; separate vanishing stars; duration 1 sec.

No. 5. Seen at $7^h\ 58^m\ 4^s$, started about 2° from *γ Andromedæ* and moved 2° in the direction of *γ Pegasi*, equal to 3rd magnitude star. Colourless as a spark; duration 1 sec.

No. 6. Seen at $8^h\ 20^m$, started 1° above *γ Andromedæ*, and moved 2° in the direction of the first radiant. Colourless; 3rd magnitude; duration 1 sec.

No. 7. Seen at $8^h\ 52^m$, the motionless meteor close to *γ Andromedæ* before described.

No. 8. Seen at $9^h\ 1^m\ 20^s$, moved from direction of *γ Andromedæ* towards *λ Andromedæ*, path amongst the stars 11°. 2nd magnitude; red; duration 1·2 sec.; separate vanishing star.

No. 9. Seen at $5^h\ 50^m$, could be referred to either radiant, moved from direction of *γ Andromedæ* towards south south-west horizon, starting 6° from *γ Andromedæ* and moving 4° amongst the stars. 3rd magnitude; colourless; duration 1 sec.

No. 10. Seen at $6^h\ 2^m$, moved in the same direction as the last, starting 17° from *γ Andromedæ* and moving 10° amongst the stars. Red; equal to 1st magnitude star; left a continuous streak which soon vanished; duration 1·5 sec.

No. 11. Seen at $7^h\ 4^m$, in every respect similar to the last mentioned, moving parallel with it, only about 2° more westerly.

No. 12. Seen at $7^h\ 11^m\ 40^s$, moved from the direction of the radiant almost across *β Cassiopeiæ*, vanishing $1\frac{1}{2}$° beyond this star, path about 10°; 2nd magnitude; colourless, separate sparks; duration 1·5 sec.

No. 13. Seen at $7^h\ 19^m$, from direction of *γ Andromedæ*, just west of No. 11, path 10°. Colourless; 1st magnitude; slight streak; duration 1·5 sec.

No. 14. Seen at $7^h\ 21^m$, moved from direction of *γ Andromedæ*, moving 10° towards *Capella*, and vanishing about 4° from that star. 2nd magnitude; red; separate star; duration 1 sec.

No. 15. Seen at $7^h\ 40^m\ 20^s$, moved from close north of *β Cassiopeiæ*, from the direction of the radiant, and passing 10° to north-east. 2nd magnitude; red, separate stars; duration 1 sec.

No. 16. Seen at $8^h\ 42^m$, moved from 7° north-east of the radiant towards *α Cephei*, path 8°; 2nd magnitude; colourless, spark-like; duration 1·1 sec.

No. 17. Seen at $8^h\ 42^m$, moved from direction of *γ Andromedæ*, in the same direction as Nos. 9 and 11, starting 10° from *γ Andromedæ*, and moving about 7° amongst the stars. 2nd magnitude; colourless, separate stars; ill-defined, duration 1 sec.

No. 18. Seen at $9^h\ 16^m$, from the direction of the radiant, starting 1° south of No. 16 and being very similar. Duration 1 sec.

Four or five times during the display there were noises in the north-west and west north-west, which closely resembled that produced by very distant gun-shots. Once at $7^h\ 30^m$ P.M., this followed by the interval of about a minute a discordant meteor which shot rapidly from *Polaris* to near *Capella*. This meteor moved very rapidly, and left a streak in the sky visible for a second of time throughout the entire distance between these two stars. Its size exceeded a 1st magnitude star. Again, after the sky became overcast, at $12^h\ 40^m$ A.M., and three times at about $4^h\ 15^m$ A.M. These noises were repeated, and I have since ascertained that they were heard several miles north-west of this place. During the ordinary November epoch I have heard similar noises, so that I conclude they were connected with the phenomenon.

There was an evident tendency in the meteors to follow each other, sometimes some three and four passing along the same path; this, however, is not an uncommon feature in star-showers, the chief difference being that mostly the meteors were very similar in size, though in other displays one was much larger than the other as a rule.

The frequency of the meteors was in impulses of short periods, though not regular. Mostly the impulses were nearly in half-minute periods with more frequent impulses (*i.e.*, attaining a maximum) every five or six minutes. Between 6.30 and 7.30 these impulses were in 20 sec. periods each time, lasting about 8 sec. Later in the evening these impulses in frequency had attained to about six minutes, lasting each time from 7 sec. to 10 sec., whilst after 10 P.M. they were not distinguishable.

A number of the meteors' paths were recorded, yet from their frequency and similarity, it does not appear that a detail of more than a few of the most dissimilar and large ones would be useful for comparison. The following, however, may be mentioned, but before doing this I wish to point out another singular feature. The sky from 5 P.M. to 10 P.M. was free from cloud, and from 5 P.M. to 7 P.M. the stars were very bright, and the air very clear. After 7 P.M. until 10 P.M. there was a peculiar gauze-like veil that very much dimmed the stars, yet did not appear to dim the meteors. It was certainly peculiar and reminded me of the haze that was so noticeable on the first evening of the appearance of Donati's Comet.

$6^h\ 12^m$ a red meteor = 2nd magnitude star passed from μ across α *Andromedæ*. Streak; duration 1·5 sec.

$6^h\ 21^m\ 10^s$ orange red = 1st magnitude star from the direction of radiant across α *Arietis*. Tail duration 1·2 sec.

$7^h\ 2^m\ 15^s$ = 1st magnitude star, colourless, from *Caput Medusæ* across the *Pleiades*. Separate stars; duration 2 sec.

$7^h\ 21^m$ = 1st magnitude star, bluish streak which lingered from λ *Draconis* across δ *Ursæ Majoris*. Duration 4 sec.

$7^h\ 46^m\ 5^s$ = 1st magnitude star, red, streak from ε *Cassiopeiæ* to near *Polaris*. Duration 2·5 sec.

$7^h\ 55^m$ = 2nd magnitude star, red from near radiant across *Cassiopeia*, leaving a streak that lasted 2 minutes.

$8^h\ 1^m$ twice, size of 1st magnitude star, from α *Persei* to just above *Capella*. Red streak, lasted 2·7 sec.

$8^h\ 12^m\ 30^s$ = 1st magnitude star, separate stars, blue, from β *Cephei* across δ *Draconis*. Duration 2·4 sec.

$8^h\ 16^m\ 2^s$ = 1st magnitude star, from α *Ursæ Majoris* across κ *Ursæ Majoris*, red streak, which faded instantly. Duration 3·5 sec.

On the Meteor Showers of November 27, 1872. By Lord Rosse.

An extraordinary display of meteors was seen here on the night of November 27th. The first notice of the phenomenon was given about 7 P.M.* local time, by a friend, Mr. Garvey, who afterwards kindly took part in the observations. At that time probably forty meteors a minute were seen to issue from a point of the heavens near γ *Andromedæ*; the greater part of them were very small, being not brighter than stars of the third or fourth magnitude, but some even rivalled *Jupiter* in brilliancy. Very few remained in sight for longer than a fraction of a second, and only an occasional bright one left a faint train behind it. When the display was at its height, six or seven meteors occasionally issued from the radiant point at the same time, as many as seventy-nine being counted by two persons in a minute. From the beginning they were so numerous that it was thought advisable to be contented with merely counting the number that fell in a given interval of time. As, however, this plan could not be fully carried out, every effort was made by two observers, the one looking east, the other west, to secure all that were visible during the actual time of observation, and afterwards the gaps were filled up by means of a rough interpolation. Although there was more or less fog the whole night, still, except where it is expressly stated, it did not reach high enough to interfere with the observations. The results of the counting are given in the following table, of which the columns are, 1st, the Greenwich mean time of the beginning of each interval of observation or non-observation; 2nd, the duration of the interval in minutes; 3rd and 4th, the numbers of meteors seen in the eastern and western halves of the heavens respectively; 5th, the observers' names, who were Mr. Garvey, Dr. Copeland, and the amanuensis Leahy, denoted by G., C., and L.; 6th, the average number of meteors a minute seen by two observers; 7th, the total number of meteors for the interval. The numbers in brackets have been deduced from the others by interpolation.

h m s	m					
†7 47 0	$26\frac{2}{3}$	140	[160]	C	49·0	[160]
7 53 25		510	497	C G		1147
8 13 40	[$1\frac{1}{3}$]	..	..	..	[50·0]	[67]
8 15 0	13	387	299	C G	52·8	686
8 28 0	[13]	..	..	..	[56·4]	[733]
‡8 41 0	11	[50] / 230	381	C L	60·1	611 / [50]
8 52 0	[49]	..	..	..	[42·1]	[2063]

* The display of meteors was noticed half an hour or more earlier by persons in the immediate neighbourhood.

† For $6^m\ 25^s$ only one person was on the look-out, the [160] therefore allowed for the second observer.

‡ One observer occupied for 2 minutes in making notes; 50 meteors allowed.

h m s	m					
9 41 0	11	128	138	C L	24·1	266
9 52 0	[6]	..	..	..	[22·4]	[134]
9 58 0	10	97	111	C L	20·8	208
10 8 0	[15]	..	..	..	[20·5]	[307]
10 23 0	10	94	109	C L	20·3	203
10 33 0	[7]	..	..	..	[17·7]	[124]
10 40 0	10	52	93	C L	14·5	145
10 50 0	[3]	..	..	..	[14·5]	[43]
10 53 0	10	69	76	C L	14·5	146
11 3 0	10	45	45	C L	9·0	90
11 13 0	10	49	50	C L	9·9	99
11 23 0	10	34	42	C L	7·6	76
11 33 0	4	17	13	C L	7·4	30
*11 37 0	[141]	..	..	..	[4·1]	[578]
13 58 0	30	24		C & L	0·8	24
14 28 0	10	5		C & L	0·5	5
14 38 0	..	..		..	..	..
				Number counted		3736
				Number estimated		[4259]
				Total		7995

It will be seen that in 176 minutes, 3736 meteors, which belonged almost exclusively to one system, were actually counted, and it is believed that the 4259 assumed for the remaining 235 minutes is rather below than above the truth.

During the interval from $8^h 52^m$ to $9^h 41^m$ an attempt was made to determine the radiant point, but the only maps at hand being those of the Society for the Diffusion of Useful Knowledge, and the radiant point falling almost exactly on the edge of sheet 1, it was very difficult to lay down the paths of the meteors satisfactorily. Fifteen tolerably accordant meteors gave the radiant point in R.A. 24° 39′, N. Decl. + 43° 39′; or in Long. 39° 58′, N. Lat. + 30° 53′, for 1872·0.

Observatory, Birr Castle, Dec. 2nd, 1872.

Observations of the Meteoric Shower of November 27, 1872.

By Vincent Fasel, F.R.A.S.

(*From a Letter to one of the Secretaries.*)

Enclosed, I beg leave to transmit to you, to be submitted to the Astronomical Society, the following report on a meteoric shower witnessed here on the 27th of November last.

* Sky almost completely overcast during this interval.

In the early part of the evening of the 27th ult. some indications of a meteoric shower being about to take place having been noticed, I lost no time in posting myself in as good a place of observation as possible, and away from all interfering lights. I stood facing that part of the heaven, over the northern horizon, having in front of me *Ursa Major* and the *Sickle* in *Leo*, and just north of the zenith were part of *Cepheus*, *Cassiopeia*, and part of *Perseus*. The following result was obtained from my observations:—

L.M.T.			
h m h m			
From 7 45 to 8 0 P.M.	150	Meteors were counted.	
8 0 to 8 15	243	,,	
8 15 to 8 30	142	,,	Sky getting cloudy.
8 30 to 8 45	35	,,	
8 45 to 9 0	85	,,	Cloudy, but clear over head
9 0 to 9 15	96	,,	Sky partially cloudy.
9 15 to 9 30	108	,,	Clouds over Ursa Major and Leo.
9 30 to 9 45	106	,,	
9 45 to 10 0	95	,,	Sky much clouded.
	1060		

As the sky was not at any time quite clear, the above number (1060) may be fairly doubled, and even trebled, to make up for those I missed through the clouds.

The display continued till midnight, but the prevalence of clouds soon convinced me that any further watching would serve to little purpose.

The characteristics of the display were the following:—

1. The general direction of the meteors was from S. by W. to N. by E. Very few took another course; in fact, most of the meteors that I saw start *from* and *north* of *Perseus*, *Cassiopeia*, and *Cepheus*, preserved, during the whole evening, a very remarkable parallelism in their tracks, and tended to the *Pointers* in *Ursa Major* and the *Sickle* in *Leo*.

2. The trains of light were not quite so brilliant as in 1866, and mostly presented the appearance of luminous dust or red sparks; they were short, about three or four degrees.

3. The greater number of the meteors were bright, and ranged from the second to the fifth magnitude; in some instances nothing was visible but the train. Their colour was yellow, orange, a few red, and some near the horizon presented a bluish light. Three or four of a whitish colour, having no train, appeared like small tennis-balls.

4. The meteors for the most part were observed to be most numerous in the area bounded by *Capella*, *Perseus*, *Andromeda*, and *Cepheus*, right to *Ursa Major* and the *Sickle* of *Leo*. They were not very rapid in tracing their course.

5. The radiant point on this occasion was, if I am not mistaken, a few degrees south of δ *Cassiopeiæ*.

6. A few minutes after 9^h P.M. (I omitted to state) a bank of auroral cloud rose up to the head of *Draco*, but soon vanished again.

7. No flashes of lightning were seen during the evening, nor any trace of the zodiacal light early next morning.

Morges, Switzerland, 28th December, 1872.

The November Meteors. By the Rev. S. J. Perry.

A constant watch was kept here from $8^h\ 30^m$ P.M. until daybreak on each night, from the 10th to the 17th of November, with the view of detecting any possible outlying streamlets of the great meteor current, or of establishing their non-existence. The nights previous to the 13th were very favourable for observation, although the Moon, whose age corresponded with the day of the month, would have prevented any bodies of the (5–6th) magnitude from being seen in its vicinity. The following were noted by one observer, who faced always the direction of *Leo*:—

Nov. 10th, 8.30 P.M. G.M.T. to midnight; sky very changeable; 5 meteors observed, 1 Leonid.

11th, midnight to 3.15 A.M. { almost cloudless, Aurora Borealis } 13 meteors observed, 5 Leonids.

3.15 A.M. to 5.10 A.M.; sky almost covered; 2 meteors observed, 1 Leonid.

8.30 P.M. to midnight { almost cloudless, Aurora Borealis } 2 meteors observed.

12th, midnight to 4.40 A.M.; almost cloudless; 8 meteors observed, 3 Leonid.

12.8 A.M. meteor from β *Leonis* to horizon, at a point whose azimuth was 5° E. of β; magnitude $>$ *Sirius*; colour, yellow; trail, bright yellow.

4.40 A.M. to 6.40 A.M.; sky clear at times; 4 meteors observed, 2 Leonids.

5.18 A.M.; a meteor $>$ *Jupiter*, with bright red train, and emitting sparks, appeared half way between *Procyon* and the head of *Hydra*, disappearing behind a cloud that obscured *Corvus*.

8.30 P.M. to 10.0 P.M.; passing clouds; 1 meteor observed; no Leonids.

10.10 P.M. to midnight; cloudless; 3 meteors observed; 1 Leonid.

10.13 P.M. A magnificent meteor, whose course traced backwards would have passed through the *Lion*, which was then considerably below the horizon. It was first observed between the *Twins* and the *Great Bear*, at some 20° above the N.E. horizon; then it moved slowly towards the zenith, where it passed through *Cassiopeia*, and thence descended towards the S.W. horizon, disappearing quietly at perhaps less than 20° from the horizon. The colour of the head was an orange red, and the minute sparks, or fiery dust, that seemed to be continually rubbed off to form the tail, did not differ in colour,

and extended to a distance of more than 40° from the head. The tail appeared to widen out at first, and then to contract from loss of light, as if its component parts were rapidly extinguished. The meteor occupied about 7ˢ in its path of something like 140°, and no portion of the tail was visible for more than 3ˢ after the passage of the head. The velocity slightly diminished before disappearance.

Nov. 13th, midnight to 2.30 A.M. Sky nearly cloudless; 5 meteors observed, 3 Leonids.

2.30 A.M. to 6.30 AM. Sky half covered; 1 meteor observed, 1 Leonid.

6.40 A.M. A meteor as bright as *Sirius*, from 10° W. of *Regulus* to *Procyon*.

13th–14th. Sky overcast all night.

14th, 9.0 P.M. to midnight. Sky mostly clear; 6 meteors observed, 1 Leonid.

15th, 12.25 A.M. to 1.24 A.M. E. sky clear; 4 meteors observed, 4 Leonids.

2.0 to 5.10. Rather cloudy. No meteors observed.

5.10 to 6.30. Clouds gathering fast.

6.1 to 6.14. Ditto; 4 meteors observed, 4 Leonids. One of these last was as bright as *Jupiter*.

15th–17th. Nights overcast.

There seems therefore to be a fair probability that not even a partial shower occurred during the night hours previous to the evening of the 13th.

Stonyhurst Observatory.

Observations of Luminous Meteors. By William F. Denning.

(*Abstract. Communicated by Mr. Proctor.*)

During the first half of the month the sky was carefully watched during a portion of each favourable evening for observation, but very few meteors were observed. On the 6th, 9th, and 10th, the paths of twelve small shooting stars were, however, mapped, and the radiant point found to lie in *Taurus* a few degrees N. of α *Tauri*, or, more definitely, at R.A. 64° and N. Decl. 20°. This result coincides in a remarkable manner with a determination previously made by Messrs. Greg and Herschel (*Monthly Notices*, No. 9, vol. xxxii.), who found, from observations made of meteors seen from October 25th to November 22d, 1871, a radiant at R.A. 64° and N. Decl. 18°. A meteor seen on the 6th at $11^h\ 5^m$ was not, however, conformable to the point of radiation stated, as it appeared to diverge from the star μ *Geminorum*. This meteor was about equal in brilliancy to a 2d mag. star. Only one of the Leonides was visible. This one appeared near β *Aurigæ* on November 9, $13^h\ 50^m$, and was very faint. On November 12th and following nights the moon was very bright, and no meteors were observed, though a watch for

their appearance was maintained for some time on the evenings mentioned. On November 23d, at $7^h\ 20^m$, however, a meteor of considerable brilliancy came under my notice. Coming from a place at the extreme N.W. part of *Andromeda*, and passing through the sword-hand of *Perseus*, and onwards through *Camelopardalis*, it became extinct, as if burnt out, on reaching the head of *Ursa Major*. I distinctly noticed that in its flight the meteor faded several times, and revived again with great rapidity, but this may possibly be accounted for by the presence of clouds at some parts of its course. It was brighter than *Venus* at her best, and was the largest meteor that has come under my observation subsequently to February 13, 1871. Later in the same evening ($11^h\ 5^m$, Nov. 23) another much less in apparent size passed W. of *Procyon* in *Canis Minor*, and evidently came from the point of emanation at the *Hyades*. On November 25th I witnessed the appearance of three small meteors, whose courses prolonged backwards would meet at the feet of *Andromeda*, thus proving their radiant point to be analogous to that of the large meteor of the 23d.

On the following evening there was another meteor of the same stream seen, but it was very small. Indeed, with a single exception, all those which came under my observation were very insignificant, and I find in my note-book a remark as to the extreme paucity of meteors up to the 26th, and am of opinion that these bodies had been very rare, and, in fact, considerably less in numbers than in former years. No doubt this must have been partially attributable to the presence of the Moon on the nights of the 12th and 13th, which must necessarily have obscured any of the smaller class of meteors that may otherwise have been perceptible. Under these circumstances, it was not deemed essential to continue observations after the 26th. Early in the evening of the 27th, at $5^h\ 50^m$, however, I happened to witness the appearance of a meteor or fire-ball of considerable magnitude in the northern sky. Its motion was very slow, and in its flight it emitted sparks, ultimately disappearing near *α Ursæ Majoris*. Its radiant point seemed to be in the direction of a place W. of *Polaris*, and the light it emitted exceeded that of *Venus* when at her maximum. After having seen this meteor, I kept my attention directed on the sky, which I may remark was at this time, and indeed throughout the entire period of my observations, in an extremely misty and cloudy state, and I could scarcely distinguish the Polar Star or the brighter stars in *Ursa Major*. At about $5^h\ 55^m$, four other meteors, at least as bright as stars of the 1st mag., succeeded each other with great rapidity, and their paths were in remarkably close agreement. They all followed a similar track to that of the fire-ball seen at $5^h\ 50^m$, and disappeared in *Ursa Major*. At $6^h\ 5^m$ I commenced a careful watch, in conjunction with a friend. We continued our observations until $6^h\ 30^m$, at which time the sky became densely overcast, and remained so throughout the rest of the evening. Between $6^h\ 5^m$ and $6^h\ 30^m$ we had succeeded in noting 74 additional meteors. Of

these about 10 were seen which must have been quite as bright as, and some brighter than, 1st mag. stars. The meteors generally were, however, inferior in size to those which came under my observation on the night of November 13-14, 1866. The largest ones were visible at considerable distances from the radiant point, and were most frequent near *α Lyræ*, *α Ursæ Minoris*, and *α Ursæ Majoris*. It was not easy at first to determine the situation of the radiant point, but after attentive watching it was discovered to lie at a point about 5° N. of the star *Almaach* (*γ Andromedæ*), or in R.A. 1^h 56^m, N.D. 46°.

Several small meteors, with their paths of necessity extremely foreshortened, were seen in close proximity to this place. Two others, apparently stationary, were also noticed almost in the exact point of divergence, and only one shooting-star was seen whose path was not conformable to the radiant point indicated. I did not see any trail of light subsequently to the disappearance of any of the meteors, nor was any sound, as of an explosion, audible. Attention was principally directed to the accurate determination of the radiant point, and to the numbers of meteors visible, therefore several other details of the shower were not recorded. I am inclined to believe that all the meteors which came under observation were quite as bright as 2d mag. stars, but clouds obscured the great majority of those which must actually have existed.

On the evening of the 28th the sky was cloudless throughout, and I watched for meteors at intervals, but only saw one. This was at 5^h 45^m. It was as bright as a 1st mag. star, and appeared to emanate from *Perseus*, passing perpendicularly downwards to the N.E. horizon.

It may be interesting to note that on the 24th, at 3^h A.M., a strong display of Aurora was perceptible in the N.E. sky, and on the evening of the 27th also, correspondents describe the occurrence of a similar phenomenon.

Hollywood Lodge, Cotham Park, Bristol.

Meteor Shower of Nov. 27, 1872. By M. O. Pihl.

On Wednesday, November 27th, the sky, which had been overcast more or less for weeks together, became clearer,—and towards the evening parts of the heavens were at times without a cloud ; the atmosphere however was far from transparently clear. During one of these brief intervals of brightness a party, which included Professor Fearnley and Mr. Geelmugden of the Royal Observatory, Professor Mohn, Professor Rubenson from Upsala, and myself, observed a shower of meteors. As the break in the clouds extended, in which the shooting-stars were seen, the centre of radiation was found to be very near to *γ Andromedæ*, but it appeared gradually to change its position to within two degrees

or so north-west of that star. During the first five or six minutes about twenty shooting-stars were observed, and the sky continuing to clear, especially round the centre of radiation, their frequency rapidly increased. A systematic counting of the meteors now commenced, and from $8^h\ 25^m$ P.M. till $8^h\ 50^m$ Christiania mean time ($7^h\ 42^m$ till $8^h\ 7^m$ Greenwich time) 500 meteors were observed, and 100 during the next four minutes. Then the sky became again quickly overcast, and after the lapse of about seven minutes, during which 63 meteors were seen, it was entirely covered with clouds, which did not afterwards disperse.

We did not observe more than eight-tenths of the larger fireballs with trains of yellowish sparks, which were so numerous in the meteoric shower on the 13th and 14th November, 1866. One of these large meteors, of a brilliancy greater than that of *Venus*, left behind it, in the direction of its orbit, a phosphorescent light, which was visible for upwards of two minutes, continually changing in shape, and at last forming an arc with a considerable curve.

I have thought it right to transmit to the Royal Astronomical Society the present communication, as possibly the phenomenon may, owing to the state of the weather, not have been observed in England,—and, as it is without doubt attributable to Biela's Comet, the descending node of whose orbit was passed by the Earth a few hours previously. It seems reasonable to presume that the meteors have formed parts of the lost comet, which has been drawn out in a band, as shown to have been the case with other periodic systems of shooting-stars.

Professor Fearnley and Professor Bruhns have called attention to the fact, that the orbit of Biela's Comet intersects that described by the November meteors, which, according to the calculation of the former gentleman, was passed by the comet on the 6th,* and according to Professor Bruhns' calculation on the 3rd of January, 1846,† and they presume that the cleaving of the comet, which was for the first time observed by Maury respectively seven and ten days after the dates named, was effected by this intersection. Both astronomers consider it probable that something similar has taken place in 1859, and that this has caused the non-appearance of the comet, 1865–1866. Professor Fearnley considers this so much the more probable, as the years 1846–1847 as also 1826 (1859–33) are noted among the years in which the Leonides were numerous.

It seems therefore probable that the meteors now observed are the *débris* of one of the late catastrophes (1859, possibly also in 1866).

Tullinbjerget, Christiania,
December 3rd, 1872.

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* Paper read at the Royal Scientific Society, in Christiania, 15th February, 1867 (*Forhandlinger af Videnskabsselskabet i Christiania*, for 1867, pages 15–16.)

† In a letter of the 20th February, 1867, to the Editor of the *Astronom. Nachrichten* (*Astronomische Nachrichten* vol. lxviii. page 365.)

The Meteoric Display of November 27th.
By P. F. Denza.

(*From a Letter to the Astronomer Royal.*)

Yesterday evening, November 27th, a great shower of meteors was observed here. We counted 33,400 in six and a half hours, or from 6^h 0^m to 12^h 30^m local time. There were four observers. The meteors were very brilliant and were noticed in every part of the sky. The number recorded above is far less than the truth, for we found it frequently impossible to count them. The maximum display took place between 7^h and 9^h, and for 21 minutes between 6^h 35^m and 6^h 56^m, the appearance in the sky was that of a meteoric cloud. The radiant point was very clearly indicated near *γ Andromedæ*.

Moncalieri, November 28, 1872.

Note on the Meteors of November 27th, 1872.
By J. M. Wilson, M.A.

Meteors were observed at Rugby as soon as it was dark. A haze came on at 6.45 which stopped further observation. From 5.30 to 6.45 they were falling at various rates from 12 to 40 a minute; the time of maximum being about 6.37. They came in volleys for the most part, and many were very faint, and probably many were overlooked.

By observing especially the meteors with short paths, I judged that the radiant area included the triangle *ξ Cassiopeiæ*, *γ Andromedæ*, and *ζ Andromedæ;* and yet the majority radiated from the neighbourhood of the point N.D. 48°, R.A. 12°.

On the night of the 25th, also, from 10.50 to 11.50 were many meteors, most of them sporadic, but many indicated a radiant near N.D. 45°, R.A. 350°.

Temple Observatory,
November 30th.

Meteoric Shower. By Miss Readhouse.

Miss Readhouse, of Newark, writes:—

"Last night we had a grand display of meteors. I counted 201 meteors in 14 minutes, and on several occasions, so rapidly did the meteors fall, we could not count them correctly.

"As soon as I had satisfied myself as to numbers in a given time, I got a celestial globe, and endeavoured to find out the radiant point, which approximately was 18° R.A. and 45° N.D.

"Sometimes however they seemed to indicate a point nearer to *Triangulum* and *Andromeda*.

"*Castle Gate, Newark, Nov. 28, 1872.*"

Note by Mr. Hind, on the Radiant Point of the Meteors, observed in 1872, November 27.

(*From a Letter to the Astronomer Royal.*)

Mr. Barber, of Spondon, Derby, a very competent observer, fixed the radiant of the meteor shower on November 27, in R.A. $1^h\ 44^m$ and N.P.D. 46°. I find meteors moving in the orbit of Biela's Comet (using the elements at the last perturbed epoch 1866), would radiate from R.A. $1^h\ 41^m$, N.P.D. 48°, which appears a marvellously close agreement.

I find the following distances of the Comet from the Earth's orbit at the descending node, which is passed about a month before perihelion, in various years. + indicates that the Comet crossed the plane of the ecliptic outside the Earth's path, and — within it:—

1772	−0·06545	Hubbard.	
1806	+0·01321	„	
1826	+0·00892	„	
1832	+0·000866	Baranowski.	
1839	−0·000089	Santini.	
1846	−0·01680	Hubbard	Mean for two nuclei.
1852	−0·01130	„	
1859	+0·00567	Michez.	
1866	+0·01295	„	

There were showers of meteors when the Earth passed this node in Dec. 3, 1798, and 1838.

Dec. 3, 1872.

Future Solar Eclipses. By J. Maguire, Esq.

There can be no doubt that Hallaschka has made a great mistake in his treatment of the eclipse of the 28th May, 1900. Upon reading the Rev. S. S. Johnson's paper in the last Number of the *Monthly Notices*, in which he states his belief that this eclipse will be total in the south of Spain, I referred to Hallaschka's map, and found that he described it as annular. Turning to p. 99 I extract these items from the Elements:—

Moon's horizontal semi-diameter		$15'\ 40''{\cdot}8$
Sun's	„	„	$16\ 14{\cdot}5$!

Both these are incorrect. The Moon's semi-diameter is about 10″ greater than the Sun's. The eclipse will, therefore, be total.

In his long search for the next total solar eclipse visible in London, Mr. Johnson has discovered that on the 14th June, 2151,

the central line of such an eclipse will pass to the north of London, London being well within the southern limit of totality.

I am rather inclined to dispute the accuracy of this conclusion and to place the line to the north of Norwich. As, however, the elements which I have used in the computation are not of a sufficiently reliable character, I must leave the decision of the point, at present, an open question.

Norwich, 6 *Nov.* 1872.

On the Zodiacal Light. By V. Fasel.

Inclosed, I beg leave to transmit to you, to be submitted to the Astronomical Society, the following observations on the interesting phenomenon, the Zodiacal Light, witnessed here by me in the early part of the year.

On the evening of the 28th February last, at $7^h\ 30^m$ L.M.T. I had an opportunity of observing a faint, but very distinct, white light, in the south-west part of the heavens, which, from its position and form, I concluded to be the Zodiacal Light. It exhibited, though with a solution of continuity in the vertex, the figure of an inclined cone whose axis, if produced, would have passed to the right of the *Pleiades*. The boundaries of the light were not well defined, especially in the southern edge. A line drawn from about 3° north of ε *Arietis*, passing through γ *Arietis*, and within 2° north of η *Piscium*, will indicate the upper or northern edge. The lower or southern edge, though *very* faint, will be fairly pointed out by a line drawn from about τ and δ *Arietis*, but south of them, passing between λ and μ, and very near to ν *Ceti*, and involving α *Piscium*. The contour of the apex, owing to the faintness of the light, could not be traced, but near the axis and downward to the horizon the light grew brighter. The sky was clear, the state of the atmosphere calm, and the absence of the Moon and clouds permitted the interesting display to be comfortably examined.

On the next night, 29th February, at 8^h L.M.T., the Zodiacal Light was again visible, but with considerably less brilliancy than the previous day; nothing was sufficiently well defined to allow a fair observation in the details of the phenomenon.

On March 3rd, at $8^h\ 30^m$ P.M., the Zodiacal Light was more conspicuous and brighter than on the two previous occasions. A line drawn from about 5° north of δ and through γ *Arietis*, passing within about 2° north of η *Piscium* downward to the horizon, wil' indicate the northern edge; and a line from about 2° south of δ *Arietis*, passing very near to ν *Ceti* and downward involving α *Piscium*, will show the southern edge which was much shaded off. The sky was clear and cloudless, and the absence of the Moon was most favourable to a better view of the phenomenon.

On the following night, March 4th, at $7^h\ 35^m$ P.M. L.M.T., the

Zodiacal Light was again visible, and decidedly more brilliant than before; its light was certainly brighter than the Milky Way, especially near the axis and just above the horizon, but gradually faded off at the borders. The boundaries were well defined, chiefly the upper one. A line drawn from about 5° north of *δ Arietis* and through *γ Arietis*, passing within 2° north of *η* and within 4° north of *ε Piscium*, will indicate the northern edge; as to the southern one, it will be pointed out by a line drawn from about *δ Arietis*, passing between *λ* and *μ* and very near to *ν Ceti*, and downward involving still *α Piscium*. The extent of the base was about 20°; as to the axis, it was *not* coincident with the ecliptic, but rather inclined to it, according to my best estimation, about 15°.

My place of observation was unexceptionably favourable and appropriate for the purpose, or else I should not have been able to trace the outlines and observe other details of the phenomenon before me. I stood just out and to the west of the small town of Morges, on the top of a rising ground looking at a horizon formed of Mount Jura. Every possible intervening gas-light was excluded from that secluded and favoured spot.

Yet I must acknowledge that, however interesting and admirably visible the Zodiacal Light appeared to me, its display was not quite so grand and wonderfully well defined as what I saw at Clapham, in Surrey, on the memorable morning of the 14th November, 1866.

The same phenomenon occurred again, and was observed on March 5th, at $7^h\ 25^m$ P.M., and on the 7th, at $7^h\ 30^m$ P.M., with pretty near the same results and features. On the last occasion it was remarkably bright, blunted at the apex, and reaching nearly up to the *Pleiades*, quite half way between *τ Arietis* and the *Pleiades*.

From the 28th February to the 7th March I did not notice any marked shifting in the position of the axis, as will be seen by the pretty uniform boundaries given above.

The position of Morges approximately is

46° 30′ 0″ N. Latitude
6 31 0 E. } of Greenwich in Longitude
or $0^h\ 26^m\ 2^s$ fast } (Mean Time).

Maison Décoppet, Morges, Canton de Vaud, Switzerland, 4 Nov. 1872.

Note on the Binary Star α Geminorum. By Mr. Hind.

Several communications have been recently made to the Society, with reference to the motion of this double star, but the elaborate determination of the orbit by M. Thiele, of Copenhagen,

appears to have been altogether overlooked. It is published in No. 1227 of the *Astronomische Nachrichten*, and shows that there is no necessity to make the very improbable assumption of hyperbolic motion, in order to represent the whole series of observations from the year 1719 downwards, within their supposed limits of error. I transcribe M. Thiele's elements:—

Peri-astron Passage 1750·326

Peri-astron from Node or Orbit	294°	0′·8	Merid. of 1850
Node	31	58 ·	
Inclination	42	5·4	
Excentricity	0·34382		
Mean Annual Motion ..	−21″·6685		
Semi-axis Major	7″·5375		
Period of Revolution ..	996·85		

Elements of the Orbit of ξ Ursæ Majoris. By Mr. Hind.

The following elements represent very fairly — better, indeed, than any I have yet seen — the measures of this star from 1781 to 1872, including those lately given by Mr. Knott, upon which I have much relied:—

Peri-astron Passage 1875·687

Period 60·679 years.

Peri-astron on Orbit	333°	33′	1872
Node	100	42	
Inclination ..	56	20	
Excentricity ..	0·38302		
Semi-axis Major	2″·587		

Hence the following angles and distances:—

1872·0	32°·97	1″·034	1874·5	337°·91	1″·004
72·5	22·85	0·974	75·0	328·44	1·073
73·0	11·69	0·940	75·5	320·22	1·154
73·5	0·01	0·933	76·0	313·13	1·243
74·0	348·55	0·955			

The elements of this binary will no doubt be much improved by careful measures during the next few years.

On the Proper Motion of Lalande 21258 *and Groombridge* 1830.

By W. T. Lynn, B.A.

That the small star numbered 21258 in Lalande's Catalogue (which is of the 8–9 magnitude), is subject to a large proper motion, amounting to nearly $4''{\cdot}5$ in a great circle, was discovered by Prof. Argelander, and announced by him as one of the results of the Bonn observations.* This has been fully confirmed by more recent observations at the Royal Observatory, Greenwich. A comparison of the latter, which were made in 1864 and 1869, *inter se*, gives for the annual proper motion,—

$$\text{In R.A.} - 0^s{\cdot}386$$
$$\text{In N.P.D.} - 1''{\cdot}36.$$

It should be mentioned that if the place given in the Greenwich Seven-Year Catalogue for 1864 be corrected for the fractional part of the proper motion, the result is,—

Mean R.A. 1864, Jan. 1	$10^h\ 58^m\ 42^s{\cdot}55$
Mean N.P.D. „	$45^\circ\ 46'\ 33''{\cdot}67$;

and if that given in the Greenwich Annual Catalogue for 1869 be also so corrected, the result is,—

Mean R.A. 1869, Jan. 1	$10^h\ 58^m\ 57^s{\cdot}70$
Mean N.P.D. „	$45^\circ\ 48'\ 3''{\cdot}58$.

The parallax of this star has been determined by Dr. Auwers to be $0''{\cdot}27$, corresponding to a distance of 761,000 times that of the Sun, or about twelve light-years.

I avail myself of this opportunity to give another determination of the proper motion of Groombridge 1830, by means of places resulting from later Greenwich observations, in continuation of those quoted by me in *Monthly Notices* for June 10, 1870 (vol. xxx. p. 204).

The final reductions of the observations of this now famous star made in 1869, 1870, and 1871 (more have been made in 1872) furnish the following results,—

Year.	Mean R.A. Jan. 1.	No. of Obs.	Mean N.P.D. Jan. 1.	No. of Obs
	h m s		° ′ ″	
1869	11 45 25·24	2	51 20 29·98	2
1870	11 45 28·78	3	51 20 55·54	4
1871	11 45 32·19	4	51 21 21·01	4

* *Astronomische Nachrichten*, vol. liv. p. 245.

† *Astronomische Nachrichten*, vol. lix. p. 325, and *Monthly Notices*, vol. xxiv. p. 71.

If these be all reduced to the mean epoch 1870, the resulting mean place for January 1 of that year will be,—

R.A. $11^h\ 45^m\ 28^s{\cdot}74$ N.P.D. $51°\ 20'\ 55''{\cdot}51$

from nine and ten observations in each element respectively. This may now be compared with the result obtained from the Greenwich 12-year Catalogue, and a proper motion be thus deduced from a large number of observations separated from each other by a very considerable interval of time. The mean place in question is, for the epoch 1845, January 1,—

R.A. $11^h\ 44^m\ 1^s{\cdot}53$ N.P.D. $51°\ 10'\ 10''{\cdot}90$,

derived from thirteen and sixteen observations in each co-ordinate respectively.

The annual proper motion deducible from a comparison of these two results, the epochs of which are twenty-five years apart, is,—

In R.A. $+\ 0^s{\cdot}344$

In N.P.D. $+\ 5''{\cdot}77$.

This is equivalent to $7''{\cdot}03$ in a great circle, which is well known to be the largest stellar proper motion hitherto recognised. So far as I am aware, those of five other stars only exceed the half of this quantity, viz., 61 *Cygni*, Lalande 21185, Lalande 21258, *μ Cassiopeiæ*, and o^2 *Eridani*. The two latter of these have not I believe as yet been subjected to an investigation for parallax.

Note on the Colours of the Components of γ Delphini.

By Thos. G. E. Elger, Esq.

The remarkable discrepancies in the recorded colour-estimations of this well-known double-star, induced me in the autumn of 1866 to commence a series of observations, with a view to determine if they were due to actual changes in the colours of the components, or merely to what Smyth terms "personal chromatic equation." I am aware that, owing to the difficulty of referring star-colours to an absolute standard, observations of this nature must be to a certain extent unsatisfactory; yet, if a definite chromatic scale be used, and proper precautions taken, although we may not be able to speak with confidence as regards slight

variations in tone or intensity, we can do so respecting positive changes of tint.

In the subjoined observations I used a fine achromatic by Cooke, of 4 inches aperture, and an eye-piece magnifying 180 times.

The colours observed were referred to the diagram in Smyth's *Sidereal Chromatics*.

Between September 1866 and November 1872 I made thirty-three observations of the pair, and the results show, I think, that while the brighter star has remained constant in colour, the *comes* has, during that period, changed its tint from yellow to green, and from green to light-blue.

The colours of the pair are recorded in the *Cycle* (epoch 1839·7): A, yellow; B, light emerald. Sestini (epoch 1844·5) calls them, A, orange; B, yellow. Smyth, at Hartwell (epoch 1850·7), A, golden yellow; B, flushed grey; and Piazzi Smyth, at the Alta Vista, Teneriffe (epoch 1856·67), tabulates them, A, cadmium yellow; B, greyish tinge.

The estimates of subsequent observers are equally discordant, at least so far as the colour of the *comes* is concerned.

My observations stand as follows: —

Epoch 1866·71	A, orange[3]	B, yellow.[3]
1866·85	A, orange[4]	B, orange.[4]
1867·65	A, orange[3]	B, yellow[4], with a decided greenish hue
1867·82	A, orange[3]	B, dull yellowish green.
1868·80	A, orange[3]	B, yellow[4], with a greenish hue.
1868·85	A, orange[4]	B, dull green.
1869·64	A, orange[4]	B, greyish blue.
1869·67	A, orange[4]	B, greyish blue[4] (blue tint very decided).
1870·72	A, orange[4]	B, dull grey.
1871·75	A, orange[3]	B, greyish blue.
1872·74	A, orange[3]	B, blue[4] (very delicate).
1872·88	A, orange[3]	B, blue[4].

I may add that other pairs were observed on the same nights as *γ Delphini* (*α*, *ε*, and *μ Herculis*, for instance), my colour-estimations of which agree very fairly with those registered in the *Cycle* and elsewhere, showing that the changes of tint, just quoted, were not due to instrumental imperfections or personal peculiarities of vision.

It is noteworthy that the magnitudes of the components of *γ Delphini*, which, in the year 1839, were rated by Smyth at 4 and 7, are now very nearly equal: is it not probable that in this instance change of colour and magnitude are cognate phenomena?

Bedford, December 1872.

Note accompanying Two Charts showing the Proper Motions of all the Stars in the Catalogues of Proper Motions by the Rev. R. Main and Mr. Stone. By R. A. Proctor, B.A., Cambridge.

I have the pleasure of presenting to the Society two charts of proper motions, showing in a graphic manner the amount and direction of the motion of every star whose place in R.A. and N.P.D. was determined by Bradley, and has since been compared by Messrs. Main and Stone with the catalogues of the Greenwich Observatory. The motions are indicated by arrows attached to each star, the direction of the arrow showing the direction of the star's motion, while the length of the arrow shows the amount by which the star would move (according to the catalogues) in a period of 36,000 years. This is at least the case in all instances where the proper motion is not very great in amount; and in *every* case the length of the arrows shows the relative rate of the star motion. But as it was convenient to use the stereographic projection, in which the variation of scale is great, the arrows indicating very rapid proper motions have a length depending partly on the star's position in the projection, and the extremity of the arrow does not in these cases mark the place of the star at the end of 36,000 years. In fact, assuming a star to move for that time on a course appreciably straight, the projection of its path on the heavens would belong to a great circle, and in order that it should be correctly indicated the arrow should be curved in the projection. I have not thought it necessary, however, to attend to this consideration, which would introduce some confusion into the map, while the present arrangement as explained cannot possibly be misunderstood.

The maps show also the estimated position of the apex of the solar way according to the researches of Sir W. Herschel, O. Struve, Argelander, Mädler, the Astronomer Royal, and others. Arrows have been placed over all parts of both maps, corresponding in length and direction to the estimated apparent motion of a star of the first magnitude, supposed to be at rest, but changing in apparent position on account of our Sun's motion. Thus it becomes possible to determine at once whether a star or set of stars in any region be moving, or not, in a way corresponding (in direction or rate) with the effects due to the Sun's motion.*

Observations of the Solar Prominences. By Capt. Tupman.

In order to view the hydrogen prominences on the limb of the Sun, it has generally been thought necessary to employ a somewhat large telescope fitted with a spectroscope of great dispersion.

* Owing to the pressure of other matter, I defer the full description and discussion of the two maps. A companion paper on Star-guaging is also deferred to next month.

To show that this is a mistaken idea, I have brought for your inspection the small instrument with which the observations detailed below were made. The telescope is a common one of 3 inches aperture, with an indifferent object-glass of 40 inches focal length. The spectroscope, by Mr. Browning, is a direct vision of five prisms, producing a dispersion very little greater than that of an ordinary flint prism of 60°. There is a small tube carrying the slit and achromatic collimating lens, and a small telescope for examining and magnifying the spectrum, the whole being attached to the telescope by means of a screw adapter. The entire cost of the combination, including the pillar and claw-stand, was 18*l.*; and I have no doubt that an equally effective instrument could be made for much less.

The adjustments are very simple. The small telescope is first focussed for celestial objects and marked. The slit is then adjusted, by means of the sliding-tube, so that its edges are perpendicular to the plane of dispersion, and exactly in focus of the small telescope. The latter is best done by focussing on the lines of the solar spectrum with a very fine opening. The slit is then opened to ·002 or ·003 of an inch, moved laterally, until the C line is approximately in the middle of the field, and the spectroscope attached to telescope so that the slit is in the principal focus of the object-glass.

If the instrument be mounted in this simple manner,* the observer must rest both elbows securely upon the table in order to keep the limb of the Sun precisely on the centre of the slit. A little practice is all that is necessary. The red line due to hydrogen produces a monochromatic image of the chromosphere which partly fills up the dark C line, and, if all the focussing is good, the little tongues that cover the outer surface—especially near the equatorial regions—can be distinctly seen with this instrument. To examine different parts of the limb the spectroscope is rotated, and the slit used tangentially. The angle of rotation is measured on a divided circle attached to the telescope by a small pointer fixed on the spectroscope.

To save the eye from the glare when the full sunlight passes occasionally through the prisms, a diaphragm is placed in the focus of the eye-lens, so that all the spectrum is cut off except a little on either side of the C line. This answers perfectly. A little scale might, with advantage, be added, so as to measure approximately the length of the portion of the limb occupied by a prominence.

The zero of the position-circle may be obtained by turning the slit until the rotation of the Earth causes a prominence to travel evenly along it. Owing, however, to the want of stability in the mounting, I prefer to measure the position of the prominences from the vertex of the disk, the zero being determined by placing the slit several times horizontal and vertical by estimation.

* Viz. on a pillar-and-claw stand.

The height of a prominence above the upper surface of the chromosphere may be measured by opening or closing the slit until it just contains the prominence. The value of a revolution of the micrometer-screw for opening the slit may be found accurately by actual measurement, and turned into seconds of arc, for the radius equal to the focal length of the object-glass, by simple proportion. A focal length of 100 inches requires the slit to be open to 0·0485 inches to subtend 100 seconds of arc.

A quicker way, and quite as accurate, is to turn the spectroscope round until the top of the prominence and some other part of the surface of the chromosphere enter the field together. The angle through which the spectroscope is turned will give the perpendicular height of the prominence as in the following table, which is sufficiently accurate all the year round.

Angle.	Height.	Angle.	Height.	ngle.	Height.
°	″	°	″	°	″
10	15	22	77	34	199
11	19	23	84	35	212
12	22	24	92	36	228
13	26	25	99	37	244
14	30	26	109	38	261
15	34	27	119	39	277
16	39	28	129	40	293
17	45	29	139	41	312
18	51	30	149	42	333
19	56	31	161	43	355
20	62	32	174	44	379
21	69	33	187	45	404

Professor Respighi has seen bright prominences upwards of 6 minutes high. As yet I have only seen one 5 minutes high, and that was faint and wholly detached like a little cloud.

The depth of the stratum of hydrogen, called the chromosphere, is 4″ or 5″ at the poles, and increases to 7″ or 8″ in the equatorial regions, where its surface is generally much disturbed and dotted all over with little tongues which are really minute prominences.

The prominences seen at any instant may, of course, be very far from the true limb of the Sun. According to their height they are scattered over a zone of from 20° to 50° in breadth as seen from the Sun's centre.

In the observations that follow the two first columns require no explanation. The third is the angle of position measured from the north *point* of the disk towards the west. The next is the heliocentric latitude, and the fifth the measured height. In the case of groups the highest part is given, and the angles of position of the extremities. The *length* of a prominence is given in degrees of the limb. In every case the observation was carried all round unless there is a note to the contrary.

1872.	G.M.T. h m	Angle from North point. °	Lat. °	Height above Chrom. ″	Notes.
Sept. 5	5 30	85	+28	15	Fig. 2* very bright.
	to	110	+ 3	..	Small low prominences from 80° to 140°.
	6 20				
		260	−33	16	Fig. 1; very bright; cloudlike.
5	20 0	100	+23	..	Long low prominence, with chromosphere much disturbed for 12° or 14° on either side of it.
	to				
	20 15	280	−13	15	Fig. 3; bright; observation interrupted by cloud.
6	5 30	280	−13	30	Fig. 4; cloud-like, same as fig. 3. No other part of disk examined.
8	5 15	99	+14	..	Detached; cloud-like.
	5 20	279	−14	20	Bright; partly detached; fig. 5, same as fig. 3. From 120° to 250° not examined.
11	5 30	88	+26	..	Bright; not large; angular in outline.
		279	−15	..	Chromosphere much disturbed for 20°. 300° to 360° not examined.
12	4 45	73	+41	30	
	to	98	+16	15	
	5 20	153	−31	50	Fig. 6; intensely bright.
		173	−59	60	Fig. 7; ,, ,,
		263	−31	30	Fig. 5*a*.
16	4 30	82	+32	30	Double; cloud-like. Fig. 8.
		135	−21	..	Chromosphere much disturbed.
		337	+43	70	Fig. 9.
19	4 30	62	+53	15	
	to	82	+33	25	Bright; fig. 10. Small one near.
	5 15	147	−32		
		to	to	22	Fine group; very brilliant. Fig. 11.
		167	−52		
		237	−25		
		to	to	50	Huge mass occupying some 30° of the limb; ill-defined above; patches of different intensity.
		270	−58		
21	18 35	137	−22	50	Very bright. Fig. 13.
	to	262	−33	30	Double, something like fig. 12; bright clearly defined. The tops curve towards each other, and, I think, meet
	18 50				
		292	− 3	..	Small; bright; pointed.
		337	+42	40	Bright; double; fig 12. Apparently unconnected with it a tall faint pillar-like mass. 25 minutes later the bright horizontal portions had completely disappeared.
		339	+44	90	
		352	+57	30	Roughly square figure.

* The figures were exhibited at the Meeting, and can be seen at the Society's rooms.

1872.	G.M.T. h m	Angle from North point. °	Lat. °	Height above Chrom. ″	Notes.
Sept. 22	4 15	87	+28	..	Small p.
	to	112	+ 3	55	Much diffused; overhanging to left.
	5 15				
		132	−17	50	Double; diffused; partly pointed.
		254	−41	75	Much diffused; 13° long; a huge mass.
		267	−28		
		to	to	25	Brilliant arches. Fig. 15.
		282	−13		
		335	+40	60	Fig. 14. Same as fig. 12 of yesterday.
		339	+44	130	
		307	+12	15	
		352	+57	20	
26	4 0	59	+57	10	Number of small ones.
	to	69	+49	15	Bright; diffused edges.
	4 20	79	+37	10	Faint.
		89	+27	..	Some very small ones.
		113	+ 3	290	Very far detached.
		119	− 3	..	Some very small ones; detached one over.
		145	−29		
		to	to	..	Mass; very bright; length 6°.
		150	−34		
		174	−58	..	Small.
		249	−47	..	Small.
		260	−36	15	Double; bright.
		270	−26		
29	2 30	91	+25	..	Very small.
	to	99	+17	20	Very bright; curved far to right.
	3 0	112	+ 4	30	Bright; overhangs at either end.
		128	−12	45	Brilliant jet, curved over to left. Two very bright narrow straight jets to right.
		159	−43	15	Group.
		167	−51	45	Two sharply pointed; left hand one 30°. Examined from 20° to 195°; Cloudy.
Oct. 3	3 45	67	+49		
	to	to	to	140	Group of three; very fine.
	4 35	83	+33		
		95	+21	40	Small.
		115	+ 1	60	Small.
		130	−14	60	Long, low, suspended jet; very bright.
		165	−49	70	Diffused. Examined from 20° to 180°.

1872.	G.M.T. h m	Angle from North point. °	Lat. °	Height above Chrom. ″	Notes.
Oct. 4	3 0	64	+52	40	Faint; diffused.
	to	94	+22	22	Diffused.
	4 40	111	+ 5	22	Faint.
		121	− 5	15	Small.
		132	−16	53	Rich group; an hour later scarcely anything remained of this group.
		154	−38	35	Diffused; chromosphere much disturbed on either side.
		243 to 258	−53 to −38	40	Fine group.
		267	−29	25	Double.
		273	−23	25	Diffused.
		291	− 5	15	Small, but remarkably bright at 3·55. Totally disapp. by 4.30.
		321 to 329	+25 to +33	55	Large arch.
6	2 10	64	+52	27	Pointed; bright; little ones on either side.
	to	80	+36		Three small ones.
	3 40	95 to 107	+21 to + 9	35	Cloud-like; suspended.
		122	− 6	..	Beautiful group of jets. Fig. 18.
		129 to 137	−13 to −21	35	Long and low. Fig. 18.
		163	−47	45	4° long; top double.
		276	−20	60	Brilliant. Fig. 19; 40m later 100″.
		282	−14	50	Very brilliant. Fig. 19 *a*.
		293	− 3	30	Fine curved jet. Fig. 17.
		299	+ 3	10	Pointed.
		311	+15	45	An extremely brilliant jet that appeared and disappeared in 15m. Fig. 20.
		303 to 320	+ 7 to +24	..	Group with brilliant jets 15 to 30″. Fig. 20.
7	3 5	70	+46	60	Length 3°.
	to	80	+36	30	Long and low, occupying 7° of limb.
	4 0				
		120	− 4	..	Several very small ones.
		165	−49	30	Small.

1872.	G.M.T.	Angle from North point.	Lat.	Height above Chrom.	Notes.
	h m	°	°	″	
Oct. 7	3 5	272	−24	88	Fig. 21.
	to	282	−14	62	
	4 0	290	− 6		
		to	to	20	Arborescent groups.
		301	+ 5		
		312	+16	22	Pointed; many small ones to left.
		320	+24	12	Small and bright.
		349	+53	..	Small and faint.
	3 10	72	+44	65	Bright; diffused edges.
	to	78	+38		
	4 0	to	to	30	Group.
		90	+26		
		84	+32	90?	High detached cloud; faint.
		97	+19	20	Fine straight jet.
		111	+ 5		
		to	to	..	Chromosphere much disturbed.
		126	−10		
		132	−16	12	Very small.
		138	−22		
		to	to	48	Fine group, mostly suspended.
		147	−31		
		182	−66	..	Chrom. much disturbed for 15°.
		246	−50	15	Double.
		266	−30	51	Arborescent.
		294	− 2	92	Detached over low bright one. Fig. 22.
		299	+ 3		Group suspended, aurora-like.
		to	to	150	Fig. 22.
		305	+ 9		
		314	+18	35	Very, very bright; bluntly pointed.
		317	+ 2	30	Faint curved jet.
11	1 20	88	+28		
	to	to	to	50	Row of low diffused ones.
	2 5	111	+ 5		
		152	−36	88	Large; 6° long; cloud-like.
		259	−37	34	Diffused; large.
		268	−28	26	Large.
		288	− 8	20	Small; pointed.
		293	− 3		
		to	to	56	Beautiful group.
		304	+ 8		

1872.	G.M.T. h m	Angle from North point. °	Lat. °	Height above Chrom. ″	Notes.
Oct. 14	2 40	67	+49	15	Very faint; small; eruption of chromosphere.
	to	98	+18	15	3° long.
	4 0	134	−18	34	4° long; arborescent.
		144	−28	12	Small group.
		242	−54	30	Faint; diffused.
		269	−27	10	Very small; bright.
		283	−14	10	Bright jet.
		301	+ 5	15	Pointed; base 1°.
		310	+14	26	Bright; rectangular; breadth 12″.
		317	+20	30	Very bright; arborescent. 45m later this prominence was united to the next by a curved jet.
		323	+26	15	Faint group.
		339	+43	15	Arborescent; diffused.
		343	+46	15	Arborescent; diffused.
		to	to		
		355	+58	..	Chromosphere much disturbed.
15	4 13	72	+45	50	5° long; massive.
	4 15	83	+34	15	2° long.
	4 17	96	+21	12	Bright.
	4 19	139	−23	20	Faint.
	4 20	146	−30	20	Faint.
	4 21	153	−36	12	Chromosphere disturbed; small bright oblique jet at 153°.
		to	to		
		158	−41		
	4 22	174	−57	12	Group of small ones.
	4 28	257	−40	130	Very, very bright; 4° long; arborescent; rectangular.
	4 31	299	+ 3	15	Jet; curved; irregular; faint.
	4 33	318	+22	30	Bright; arborescent; 5° long.
	4 34	326	+30	30	Very bright; rectangular.
		331	+35	30	Oblique jet; joining preceding.
	4 38	347	+51	20	Faint.
16	3 17	73	+44	45	Bright; arborescent.
	3 23	128	−12	15	Very, very bright; faint cloud over, 40″.
	3 25	135	−19	15	Very, very bright.
	3 27	141	−24	22	Continuous mass.
		to	to		
		149	−33		
	3 35	153	−37	25	Beautiful arborescent group.
		to	to		
		168	−52		

1872.	G.M.T. h m	Angle from North point. °	Lat. °	Height above Chrom. ″	Notes.
Oct. 16	3 37	173 to 202	−57 to −86	..	Chromosphere much disturbed. Examined from 20° to 212°.
23	3 20	67	+49	10	Chromosphere disturbed.
	3 23	110	+ 6	95	Very fine; wholly suspended; arborescent.
	3 28	125 to 130	− 9 to −14	13	Group, 5° long.
	3 35	137	−21	13	3° long.
	3 40	247 to 258	−48 to −38	150	Bright pyramidal mass; many jets.
23	3 44	264	−32	20	Faint curved jet, 3° long.
	3 47	277	−19	30	Very bright; 5° long.
	3 50	287	− 9	10	3° long; bright.
	3 51	294	− 2	12	3° long. The chrom. is much disturbed from 260° round to 320°.
	3 54	320	+24	12	Small bright point.
	3 56	324	+28	19	3° long; faint.
28	2 42	68	+47	15	Chromosphere disturbed; low, faint prominences for 5°.
	2 46	85 to 107	+30 to + 8	15 70	Long row, very bright, 15″ to 20″ high; at 107° a high curved jet.
	2 52	123 to 148	− 8 to −32	10 ..	Chromosphere much disturbed; little bright jet at 123°.
	2 55	158	−43	30	Length 2°.
	2 57	201 207	−86 −88	.. 12	Chromosphere disturbed; faint prominences at 207°.
	3 2	244	−52	34	Faint; 2° long.
	3 10	324 331	+29 +36	35	Fine group with jets.
Nov. 3	3 37	89 to 98	+25 to +16	60	Bright mass; suspended.
	3 39	112	+ 3	20	Faint; 3° long.
	3 42	133 to 143	−19 to −29	10	Chromosphere much disturbed.
	3 44	149	−35	42	Bright; 4° long; pointed.
	3 48	242	−54	13	Bright; 3° long.

1872.	G.M.T. h m	Angle from North point. °	Lat. °	Height above Chrom. ″	Notes.
Nov. 3	3 50	247	−48		
		to	to	31	Bright mass.
		253	−42		
	3 56	265	−30	34	
		to	to		Very bright, flat mass.
		280	−15	20	
	4 0	286	− 8		
	to	to	to	35	Large faint arch, with low, bright prominence under it.
	4 10	302	+ 8		
		306	+12	25	Very bright, pointed and curved, 5° long.
		316	+22	15	Very bright; flat. From 286 to 319 is a continuous group.
7	1 50	47	+66	10	Very faint; 2° long.
	1 53	85	+28	..	
		to	to		Chromosphere much disturbed.
		115	− 2	..	
	1 56	139	−26	20	Faint; 3° long.
	1 57	145	−32	25	Bright; 3° long.
	1 59	160	−47		
		to	to	10	Very faint.
		167	−54		
	2 6	267	−26	22	Very bright; 4° long.
	2 8	276	−17		
		to	to	20	Very bright group.
		284	− 9		
	2 14	317	+23	10	Small bright jet. Very fine definition. The limb of the Sun is singularly free from prominences. On the disk is a chain of large spots, all approximately in latitude — 20°.
11	2 23	67	+46		
		to	to	110	Beautiful arborescent group; highest at 76°.
		83	+30		
	2 31	114	− 1	62	Detached cloud; faint.
	2 45	263	−30	28	Bright; roughly square figure.
	2 52	301	+ 9	110	Bright; tall; pointed; nearly perpendicular.
	2 57	309	+15	56	
		to	to		Beautiful group with arched jets; very bright; in three masses.
		321	+27	40	
	3 3	334	+42	15	Very faint; 3° long.
	3 4	349	+56	22	Bright; 3° long.
14	2 39	62	+49	26	Very bright; 4° long. Group.

1872.	G.M.T. h m	Angle from North point. °	Lat. °	Height above Chrom. ″	Notes.
Nov. 14	2 42	69 to 74	+43 to +38	56	Very bright; rectangular. Group.
	2 45	101 to 115	+11 to − 3	12	Group of low, bright prominences, or disturbed chromosphere.
	2 51	148 161	−36 −49	12	Long faint group of three.
	3 5	264	−28	19	Very, very bright; double; 5° or 6° long.
	3 11	270 290	−22 − 2	..	Chromosphere much disturbed.
	3 33	279	−12	17	Very, very bright; 2° long; connected with the preceding by disturbed chromosphere.
	3 36	294	+ 3	15	Very faint; 2° long.
	3 39	327 337	+35 +45	70	Beautiful arborescent group in three bright masses with arched jets connecting them.

On the Circumstances of the Transit of Venus, 1874, *Dec.* 8, *at Port Louis, Mauritius.* By Mr. Hind.

As important expeditions will proceed from England and Germany to the Mauritius for the observation of this phenomenon, the following particulars of the circumstance for Port Louis in that island may possess interest. I have adopted the longitude and latitude discussed in the Appendix to the *Connaissance des Temps* for 1845, and since continued in the table annually published with that work, viz. (with telegraphic differences of longitudes between Greenwich and Paris), longitude $3^h\ 50^m\ 8^s{\cdot}6$ east, latitude 20° 9′ 45″ south. The data of the *Nautical Almanac* are employed in their entirety.

	Local Sidereal Time. h m s	Local Mean Time. h m s	Angles for direct Image. N. Point. °	Vertex. °	Sun's True Altitude. ° ′	Sun's True Hour Angle. h m s
1st Ext. Cont.	10 56 30	17 45 55	48·2 E	157·3 E	6 16	−6 6 28
1st Int. „	11 26 58	18 16 18	41·9 E	148·5 E	12 55	−5 36 6
2nd Int. „	15 0 24	21 49 10	346·2 E	76·6 E	61 15	−2 3 18
2nd Ext. „	15 30 2	22 18 43	340·0 E	67·1 E	68 3	−1 33 45

The middle of the transit at $20^h\ 3^m\ 9^s$ mean time, or $13^h\ 14^m\ 6$ sidereal time, with the Sun $3^h\ 49^m\ 17^s$ east of the meridian at an altitude of 36° 56′. The nearest approach of centres 13′ 54″ or 0·8548 of the Sun's radius. The Sun rises at Port Louis at $17^h\ 13^m$.

Discovery of Minor Planet (128). By J. C. Watson, Esq.

(*From a Letter to the Astronomer Royal.*)

I have the honour to send you the following observations of a new Minor Planet (128), discovered by me:—

	Ann Arbor M.T.	R.A.	Decl.
	h m s	h m s	° ′ ″
1872, Nov. 25	9 49 31	4 21 44·92	+19 34 16·2
25	10 21 51	4 21 43·44	19 34 19·9
25	10 47 14	4 21 42·65	19 34 18·0
26	11 9 4	4 20 40·72	+19 34 39·7

Magnitude 9·5.

Ann Arbor, Nov. 30, 1872.

Extract of a Letter from N. R. Pogson, Esq., Madras Observatory, to the Astronomer Royal, dated Dec. 5, 1872.

Biela's Comet is my subject this time. A startling telegram from Prof. Klinkerfues on the night of Nov. 30th ran thus, "*Biela touched Earth on 27th: search near Theta Centauri.*"

I was on the look-out from comet-rise (16^h) to sunrise the next two mornings, but clouds and rain disappointed me. On the third attempt, however, I had better luck. Just about $17\frac{1}{4}^h$ mean time, a brief blue space enabled me to find *Biela*, and though I could only get four comparisons with an anonymous star, it had moved forward $2^s{\cdot}5$ in four minutes, and that *settled* its being the right object. I recorded it as—"Circular; bright, with a decided nucleus, but no tail, and about 45″ in diameter." This was in strong twilight. Next morning, Dec. 3rd, I got a much better observation of it; seven comparisons with another anonymous star; two with one of our current Madras Catalogue Stars, and two with 7734 Taylor. This time my notes were,—"Circular; diameter 75″; bright nucleus; a faint but distinct tail, 8′ in length and spreading, a position angle from nucleus about 280°." I had no time to spare to look for the other comet, and the next morning the clouds and rain had returned.

If I get another view before posting this I may be able to add a hasty postscript. The positions, the first rough, the second pretty fair from the two known stars, are,—

	Madras M.T.	R.A.	(Apparent) P.D.
	h m s	h m s	° ′ ″
Dec. 2	17 33 21	14 7 27	124 46
3	17 25 17	14 22 2·9	125 4 28

ERRATA.

Vol. xxxiii, page 21, line 22, *for* exceed five, *read* approach three.

— — , — 28, 8 lines from bottom, *for* xxv., *read* xxiv.

— — , — 33, line 33, *for* quite obvious, *read* not quite obvious.